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EDITORIAL

SOIL EROSION

THE report of the Committee on soil erosion was published in February, 1931. While it "appreciated the amount of good work voluntarily done, particularly in recent years, by progressive agriculturists", in the course of its field inspections "the committee was appalled by the wastage of soil which it saw in progress and by the lack of appreciation of the significance of the wastage on the part of many agriculturists, both large and small". Of all current agricultural practices the committee condemned the practice of clean weeding and scraping in the most emphatic terms. "The committee cannot condemn too strongly the practice of clean weeding. It feels that planting opinion is too conservative in this matter. Scraping of the soil by mamoty, *karandi*, or spear is the antithesis of good cultivation and is an evil with no saving grace except that it is easy to do".

The committee was "unanimously of the opinion that Government interference was called for", both for the purpose of discontinuing bad agricultural practices, and for the compulsory introduction of positive methods of soil preservation, but, as a compromise, suggested the application of the methods of propaganda, education, and persuasion over a period of five years "on the understanding that if conditions are still unsatisfactory, compulsion by means of legislation should be further considered".

The note of alarm sounded by the committee does not appear to have created the ferment of new ideas which it was expected to do in the planting world. The continued depression in the markets for agricultural produce made both Government and estate proprietors slow to incur new commitments, and the committee's report appears to have only afforded a subject for a sharp difference of opinion at District Planters' Association meetings till, on the motion of Mr. R. P. Gaddum, the Central Board of Agriculture, at its meeting held on 13th September, 1934, adopted the resolution that it was of the opinion "that its executive committee should consider ways and means of implementing partly or wholly the recommendations contained in Chapter V of the report of the committee appointed to investigate the problem of soil erosion". The executive commitee issued a questionnaire to 1,200 estates. This is reprinted in this number with a tabulated summary of the replies received. The most striking point in these tables of figures is that 80 per cent. of the tea estates which sent in replies continue to use the scraper. According to tables 4 and 5 the total acreage on which measures have been adopted to check soil-wash is impressive, nearly 647,000 acres, but these figures are no guide because of considerable acreages being subject to two or more anti-erosion measures. The total acreage of the tea estates submitting returns was 287,467, and the total acreage brought under control measures in these estates is 183,509. The corresponding figures for rubber estates are 178,018 and 146,779 respectively. According to the returns 144,116 out of the 287,467 acres of tea and 143,409 out of the 178,018 acres of rubber were under control at the time when the committee found the conditions "appalling". The appearance of the principal rivers and streams after a shower of rain in the hills shows that the small increase in the acreage under control since then has made very little impression. The committee of the Central Board of Agriculture is therefore faced with the question whether the time has not come for the introduction of the compulsory measures contemplated by the soil erosion committee. It has suggested legislation for the prohibition of the use of the scraper, commonly known as the *karandi*, and this question is expected to come up for discussion at the meeting of the Central Board on the 24th of September next. The District Planters'

Associations have been giving consideration to the subject during the last two months, and their discussions betray the same old sharp difference of opinion.

We do not propose to express any views on the subject at this stage. But we consider it our duty to draw the pointed attention of all concerned to the observations made in the year 1928 by Dr. A. W. Hill, C.M.G., F.R.S., Director, Royal Botanic Gardens, Kew, "Your Island seems to be slowly washing away into the sea," and to remind them that the idea of private property in land may be just a trifle over emphasized. Whoever may live in this country in the years to come must draw their sustenance from the soil of an area of land which cannot be enlarged at the will of man, and those who have temporary control of the land now cannot be allowed to exhaust that soil in the process of extracting from it the highest possible present return.

TOBACCO IN SOUTH INDIA—II

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SEASON

IT is only during the north-east monsoon under a rainfall of about 10-15 inches that tobacco is grown in South India. The crop is usually planted between the months of October and November but sometimes up to December while harvesting is carried out during the dry season from about the end of January to March. The meteorological data for three centres representing some of the important tobacco growing districts are given on the next page in a table in which the tobacco season is shown enclosed by heavy lines.

The rainfall during the first two months of the monsoon is not more than about 5-7 inches for each month but, thereafter, it falls off considerably and from January to March the precipitation is less than 1 inch per month. There are no heavy monsoonal rains as are experienced even in the dry zone of Ceylon and the crop is thus cultivated under a light rainfall which is most suited for its growth. Ripening and curing take place when dry weather is assured and there is no interference, again, from heavy or unseasonal rains. The whole crop is completed before the advent of the warm season when the temperatures become too high for optimum growth.

It is considered that the period when dew prevails from about November to February is of advantage in preventing the leaves undergoing ripening and curing from becoming too dry to be handled without damage. In the Guntur district, the presence of a moist, southerly wind known locally as *pairu gali* commencing about January and lasting usually until May is regarded as being greatly beneficial to the crop during its latter stages of growth when the weather conditions are even somewhat too dry then.

TABLE SHOWING THE METEOROLOGICAL DATA OF CERTAIN CENTRES IN SOUTH INDIA

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Guntur: Rainfall (ins.)	0·48	0·21	0·88	0·55	2·56	4·81	5·59	5·33	5·28	5·34	3·89	0·23	35·15
Temperature (°F.) ..													
Maximum	86·5	90·9	95·9	99·9	104·8	99·5	94·2	93·4	92·7	91·0	87·5	86·1	
Minimum	64·2	68·6	73·1	77·7	81·1	80·7	78·3	77·9	76·7	74·7	70·1	64·3	
Relative humidity at 8 hrs. (%) ..	86	85	84	83	72	72	78	77	81	83	82	83	
Coimbatore: Rainfall (ins.)	0·59	0·32	0·48	1·44	2·36	1·66	1·46	1·13	1·51	6·41	3·75	1·18	22·29
Temperature (°F.)													
Maximum	86·4	91·5	96·1	97·3	94·8	89·3	87·5	88·1	89·1	88·0	85·8	84·7	
Minimum	64·3	66·0	69·9	73·5	73·5	71·8	70·9	70·9	70·8	70·6	68·9	65·7	
Relative humidity at 8 hrs. (%) ..	82	80	78	79	80	80	81	83	83	84	83	82	
Trichinopoly: Rainfall (ins.)	0·68	0·56	0·43	1·65	3·14	1·41	1·57	3·83	4·83	6·90	5·57	2·61	33·18
Temperature (°F.)													
Maximum	87·5	92·4	97·7	101·1	101·6	99·0	97·3	96·6	95·2	91·2	87·2	85·4	
Minimum	67·7	68·9	72·8	77·8	78·8	78·6	77·9	76·9	75·8	74·4	72·1	69·3	
Relative humidity at 8 hrs. (%) ..	78	77	73	68	65	62	62	67	71	79	80	77	

SOIL CONDITIONS

The soils in which tobacco is cultivated vary in different districts but the most outstanding type is a black, clay loam. It is generally held that soil conditions affect the colour and texture of the leaf, the light soils producing mild, bright tobaccos and the heavier, dark soils coarse and dark types suitable for chewing and as fillers. If the soils are, moreover, rich in humus and plant food a thick, dark leaf results while those of poor fertility provided they do not limit growth are more suited to the production of light tobaccos.

In the Guntur district, Virginian tobacco is successfully grown on a black, clay loam which cracks deep in dry weather. The suitability of the soil for growing this type of tobacco is due to the fact that it is rich in lime, free lime even being found in nodules in the surface layers, thus rendering it friable. It also shows a high degree of moisture retentiveness enabling the crop to be cultivated without the aid of irrigation even if this was possible in the district. The crop grows partly on the moisture conserved in the soil from the south-west monsoon which is responsible for about two-thirds of the total rainfall in the district.

A particular type of soil found on old village sites and known as *parti* lands is regarded as being excellent for the cultivation of the local dark tobaccos. These lands command a high rental and the tobacco grown on them fetch correspondingly high prices. The soil is not as moisture retentive as the black clay soil of the Guntur district and the tobacco grown on it has, therefore, to be irrigated. Mention may be made of the tobaccos grown on the *parti* soils of Mustadabada in the Kistna district and of Chebrole in the Guntur district, the former having a high reputation as a snuff tobacco and the latter both as a cheroot and snuff tobacco. The relation between these soils and the quality of the tobacco produced on them is not clearly understood though it may possibly be due to a high potash content.

Certain areas are known to produce a better quality of tobacco than elsewhere around. In the Vedasandur-avarakurichchi tract between Dindigul and Trichinopoly the best cigar filler tobacco in South India is produced while in other centres such as Sivapuri in the Tanjore district and Meenam-

palayam in the Coimbatore district the highest quality of chewing tobacco known in South India is produced. The mapping out of such areas most suited to each type of tobacco together with an examination of the physical and chemical characteristics of the soil of these areas would be of great value.

MANURING

The tobacco crop is, generally, well manured either directly or indirectly, except in the case of the light tobaccos grown in the Guntur district. In certain areas such as between Dindigul and Trichinopoly it is considered preferable to manure the previous crop in the rotation such as *kurakkan* but this is not the general practice elsewhere and the land is well manured before planting tobacco.

Fertilisers are rarely used and the requirements of the tobacco crop in regard to the supply of nitrogen, phosphate and Potash and the effect of these on quality is little understood by the peasant cultivator.

The manuring consists of dressings of cattle manure and village refuse as well of penning cattle, goats or sheep in the field. The amount of manure used and the number of animals employed as well as the period during which they are penned depends to some extent on the type of tobacco grown, the fertility of the soil and the wealth of the cultivator.

Where the production of chewing tobacco is the chief object, intensive manuring is practised in order to produce a thick, heavy-bodied leaf considered so desirable by the cultivator in chewing types. The application of large quantities of organic manure leads to the development of a rather high nicotine and nitrogen content and especially with cattle manure to an excess of chlorides all of which are responsible for poor burning quality of the leaves. Hence in the cultivation of smoking tobaccos, and particularly of the light types, the quantity of organic manures applied should be small but this is not sufficiently realised by the growers of dark, smoking tobaccos.

In the tropics, owing to the high temperatures and the consequent rapidity in which the humus content of the soil is broken down, the presence of adequate quantities of organic matter is essential, especially in soils of poor moisture retentiveness, in order to maintain the fertility and texture of the soil.

The cultivator is, therefore, compelled to resort to heavy manuring but in order to produce a luxuriant growth which he considers desirable for most dark tobaccos he usually over-manures his crop even though it is grown primarily for smoking as cheroots. A reduction in the application of cattle manure and in the penning of cattle for smoking tobacco is thus necessary and where possible the use of green manures and compost should be encouraged.

Combustibility of the tobacco leaf is also associated with a high potash and low magnesium content. It is, generally, considered by growers of smoking tobacco that sheep or goat penning is more suitable for smoking tobacco than cattle penning and that while the former improves the quality of the tobacco, the latter is better for general growth. Cattle manure contains a high percentage of chlorides and has a lower potash content than sheep or goat manure. These factors, may therefore be responsible for this view. The importance of the relation between quality and the amount of potash available in the soil to the crop should be made clear to the grower and the use of potash fertilisers should be advocated for improving body, texture and burning quality of the better types of smoking tobacco.

IRRIGATION

With the exception of Guntur and Vizagapatam districts and the lankas (small islands) of the Godaveri and Kistna deltas, the tobaccos grown in most other districts are irrigated from wells. Where tobacco can be raised successfully without irrigation it is found to be of better quality for smoking purposes and especially for cigarette manufacture. The lanka tobaccos which are used as cheroots are thus superior to the irrigated tobaccos of the neighbourhood. Generally speaking, unirrigated tobaccos develop a lighter colour and thinner texture than when continuously irrigated. Virginian tobacco is, therefore, best grown without irrigation but where the soil conditions are such that the crop needs irrigation as was found to be the case when this type of tobacco was introduced in Mysore State the irrigation should be restricted and, preferably, confined to the earlier period of growth. For chewing and dark tobaccos more frequent irrigation is practised resulting in thicker, heavier and darker leaves.

The view is generally held by growers in the areas where tobacco is irrigated from wells that the water should be " brackish " while wells which contain " sweet " water are not utilised in tobacco cultivation. " Brackish " water is considered to give rise to a better quality of smoking tobacco of the dark types and also to the development of larger and broader leaves in the plant. Some unpublished analyses carried out by the Agricultural Chemist, Coimbatore showed that the water from certain " brackish " wells was comparatively high in potash—about 2-3 parts in 100,000 parts of water—and low in chlorides, factors which are responsible for the improvement of burning quality in tobacco. " Brackishness " according to the information given by some cultivators varies with wells of close proximity and hence the quality of the tobacco produced depends on the particular well used for irrigating it. It is even said that the type of " brackishness " of the water from wells which irrigate some of the best chewing tobaccos differs from that for smoking tobaccos. More analyses of well waters used for irrigating the best tobaccos of different types are desirable in order to understand the relationship between " brackishness " in water and quality of tobacco, for, as usually understood, the term " brackishness in waters " is associated with the presence of chlorides and for smoking tobacco at any rate such waters would adversely affect the burning quality of the crop which is irrigated.

METHODS OF CURING

The following methods of curing tobacco are adopted in South India :—

(1) Flue-curing
(2) Sun-curing
(3) Air-curing

Flue curing is only undertaken for Virginian tobacco and is carried out in special barns in which humidity and temperature are controlled by ventilators, one fixed on top of the roof and others at the base of the walls of each barn as well as by flue pipes through which heat passes from a furnace built in one of the walls. There are at present about 30,000 flue-curing barns in the Guntur district and the peasant cultivators are now quite conversant with the method of their construction and operation. In flue-curing which aims at the production of a lemon yellow colour in the leaf, the temperature within the barn is raised at

varying intervals, until a maximum of about 165° F. is reached, the humidity being controlled by the opening and closing of the ventilators. The object of this is to drive off the moisture from the leaves and also when they have turned yellow on quick drying to fix this colour by maintaining a high temperature in the barn. In the Guntur district good quality, lemon yellow leaves of Virginian tobacco are produced without difficulty by flue-curing.

Sun-curing results in semi-bright or light brown leaves and is carried out for the production of light tobaccos such as are used in the manufacture of cheap brands of cigarette, pipe, some cheroot, snuff and chewing tobacco. In this method the drying of the leaf and fixing of the colour is brought about by exposing it to the direct rays of the sun either immediately after harvesting or after allowing it first to yellow in the shade. The process in the sun takes about three weeks after which the cured leaves are removed only early in the morning when they have absorbed sufficient moisture from the atmosphere to allow of their being handled without damage. The sun-curing method is adopted for some of the Virginian tobacco that is not suitable for flue-curing and for the country tobacco grown in the Guntur district where these are exported to the United Kingdom and Japan as cheap, light tobaccos. A type of sun-curing is also carried out for a low grade of chewing tobacco which is consumed chiefly by the depressed classes in South India. After allowing the plants to wilt in the field as soon as they are harvested they are placed in pits for fermentation for a number of days. They are then exposed to the sun for a few days and bulked in sheds.

Air-curing is carried out for cigar filler and cheroot tobaccos. This is the commonest and oldest method of curing tobacco in South India. Whole plants are usually harvested and allowed to wilt over-night after which they are stocked or bulked in small circular heaps for 1-3 days. They are then hung in racks in the shade as they are or after the leaves are stripped. The curing process is very gradual, the leaf passing through the yellow stage and then becoming brown with slow drying which is complete within 3-6 weeks.

The subsequent handling of the cured tobacco in which the operations of bulking, grading and baling are carried out requires great care and in these experience plays an important part. After curing is complete, the crop requires to be conditioned so

as to make it sufficiently soft for handling. In most cases this is done by allowing the leaves to absorb atmospheric moisture over-night. They are then bulked and during this stage certain chemical changes take place which bring out the aroma of the tobacco. Rebulking is done at varying intervals depending on the type of tobacco, the method of curing and the condition of the leaf in order to prevent too great fermentation taking place. When this is complete the leaves are graded and then tied into hands containing a sufficient number of leaves to make the butt end of each hand about 1 inch in diameter, after which they are again bulked or stored until there is sufficient quantity of each grade for baling. Particular care is taken especially in the case of flue-cured Virginia to see that the leaf is in correct condition before it is baled for export, the percentage of moisture being usually 13 per cent. This is done by passing the leaves through a rehandling plant installed in the stores of tobacco exporters.

IMPROVEMENT OF CATTLE—I

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THE breeder engaged in producing the most profitable type of cattle for his purpose, whatever that may be, finds his activities and the methods which he can adopt controlled by various factors. Among the most important of the factors which require his attention are the hereditary qualities of his cattle and the environment in which they are required to live.

Varying weight is given to these two factors by breeders ; at one extreme are those breeders who attach supreme importance to breeding and consider that all their ends can be attained by continued improvement of the inherent qualities by breeding from the highest quality animals available. At the other end of the scale are those who take the pessimistic view that environmental conditions are all important and where these are unfavourable no improvement can be looked for by breeding from high quality animals.

Both schools of thought are right to some extent but neither of them contains the whole truth.

The idea that rapid improvement of the standard of cattle can be obtained by the use of stud bulls of high quality seems to be widely held in Ceylon. Many seem to believe that the whole problem consists in obtaining an adequate supply of improved stud bulls and making their use general throughout the country.

The obvious fallacy in this conception lies in the fact that little is to be gained by improving the inherent qualities of the cattle so long as the environmental conditions are such as to prevent the development and exhibition of these inherent qualities. To illustrate what is meant an extreme case may be taken. One might take a pedigree Friesian cow bred from a long line of high milk yield ancestors and with the inherited qualities necessary to enable her to give an annual yield of say 2,000 gallons of milk.

If such a cow is placed in the environmental conditions under which the village cattle of Ceylon have to exist, far from

giving 2,000 gallons of milk in a year she would certainly die long before a year had passed.

It is obvious that in this case the environment prevented the exhibition of those qualities which had been bred into the cow by the highly skilled breeders and it is apparent that along with improvements in breeding very careful attention must be paid to the conditions under which the animals will be required to live.

The village cattle are an example of cattle which have very successfully adapted themselves to the natural environmental conditions as they exist in Ceylon. The description " natural environmental conditions " is used advisedly as little or no attempt is made in the villages to alter or ameliorate the conditions by artificial means. This successful adaptation of the village cattle to their environment has been attained by generations of exposure to these conditions and is the result of the survival of the fittest. It is successful in the sense that the cattle are able to exist and to reproduce, and maintain their numbers. It may be taken that the present standard of village cattle represents the highest level which can be attained so long as the conditions under which they live remain unaltered and that no improvement can be expected from the introduction of bigger and better stud bulls unless at the same time the environmental conditions can be improved. Future progress will depend upon our ability to improve these conditions.

The most important of the environmental conditions which influence the cattle are food supply and disease.

Under existing conditions it is not far from the truth to say that the food supply available in villages consists almost entirely of such natural pasture grasses and edible shrubs which grow wild on waste lands, jungles, roadsides, etc.

This " natural supply " of food is supplemented in the case of bulls and bullocks used for carting by a supply of poonac and paddy straw. Paddy straw is also very occasionally given to cattle, not used in the cart, during times of drought and flood when the natural food supply fails.

Improvement in the food supply for cattle in villages could be obtained :

(*a*) By reducing the number of cattle.

(*b*) By extending the areas available for grazing.

(*c*) Improving the quality of the existing grazing areas.

(*d*) By growing fodder crops.

(*e*) By increased conservation of straw for use during periods of scarcity.

(*f*) By increased use of concentrate foods such as poonacs.

Theoretically all these methods of increasing the food supply are possible but in practice not all of them can be used.

No great or rapid reduction in the number of cattle can be looked for on account of lack of a means of disposal of the surplus and because of religious objections. Gradual reduction in the number of the more useless animals may be attained by an increase in the practice of castration of unsuitable bulls and better control of stud bulls.

The outlook as regards extension of existing pasture areas or improvement of their quality is not hopeful at present. Extension of the area can be obtained by clearing jungle areas ; but much expense is necessary following clearing to keep undergrowth in check, to encourage the growth of grasses. This expense is heavy and the resulting pasture by no means good. Areas of jungle are not available in all parts.

So far little success has been obtained in efforts to secure improvement of the quality of pasture in Ceylon.

The growing of fodder crops appears to be the most practicable method available at present. A number of easily grown crops such as Napier, Guinea and Gautemala grasses are available and have proved to be capable of giving very high yield of fodder from a comparatively small area of land.

In many parts of Ceylon an increased supply of paddy straw could be obtained if greater care was exercised in its collection and preservation.

Increased use of concentrates is governed by the economic position of the villager. Concentrates are expensive and their use is justified only when an increased income from the cattle can be obtained.

Benefit to the cattle and indirectly to the owner will follow increased use of concentrates but unless an immediate and visible increased cash income from his cattle can be obtained by the use of concentrates it is unlikely that the average villager will use them.

(*To be continued*)

DEPARTMENTAL NOTES

COCOA IN CEYLON

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THE main features of the cocoa crop to the Island are that—

(1) practically the whole acreage lies in a single province;
(2) the value of the annual exports is Rs. 2,000,000;
(3) cultivation to the extent of 71 per cent. of the acreage is in the hands of peasants with small holdings of less than 10 acres each.

The considerations that demand special attention being given to the better cultivation and marketing of the crop produced by small holders are that—

(1) yields are particularly low in comparison with those of other cocoa producing countries;
(2) the effects of diseases and insect attack are severe;
(3) rejuvenation of plantations appears to be necessary;
(4) the quality of the produce marketed leaves much to be desired—proper fermenting, drying and grading methods need to be introduced;
(5) prices are low and have been on the downward trend during the past ten years;
(6) Ceylon cocoa already has a name for quality and this should be safeguarded;
(7) other cocoa producing countries are taking active measures to improve the cultivation, preparation and marketing of their produce.

The following notes are presented as they may be helpful in a consideration of this subject.

I. ACREAGE AND DISTRIBUTION

The total acreage under cocoa in Ceylon is estimated to be 35,000 acres of which 92 per cent. or 32,000 acres lie in the Central Province alone, 20,000 acres in the Kandy district and 12,000 acres in the Matale district. The remaining 3,000 acres

are in the Kurunegala district of the North-Western Province, in an area contiguous to the Kandy district.

2. OWNERSHIP

Apart from one large plantation of nearly 3,000 acres, there are about 20 estates varying in extent from 100-700 acres each and accounting for some 5,000 acres. Of estates from 10 up to 100 acres each there are about 35 totalling 2,000 acres. This makes up approximately 10,000 acres leaving the greater part of some 25,000 acres composed of small holdings in the hands of peasant cultivators. Less than a third of the total acreage consists of plantations of 10 acres and above.

3. EXPORTS

The Customs figures for the past 10 years show that exports have fluctuated between $7\frac{1}{4}$ million and $9\frac{1}{4}$ million pounds or 65,000 cwt. and 82,000 cwt. per annum. The mean annual exports for the quinquennial periods since 1911 are as follows :

1911-1915	67,900 cwt.
1916-1920	66,900 ,,
1921-1925	68,900 ,,
1926-1930	75,400 ,,
1931-1935	75,000 ,,

The exports for 1935 amounted to 69,500 cwt. The figure for the half year ending June, 1936 is far below those for corresponding periods of the past few years :

1933	38,402 cwt.
1934	53,814 ,,
1935	32,823 ,,
1936	24,781 ,,

4. VALUE

The price of cocoa has been steadily declining with consequent effect upon the value of exports except in one period as will be seen from the following average figures for quinquennia periods :

	Total Value of Exports per annum Rs. mill.	Value per cwt. (In round figures) Rs.
1911-1915 ..	2·66	39·00
1916-1920 ..	2·52	37·00
1921-1925 ..	2·43	35·00
1926-1930 ..	2·9	30·00
1931-1935 ..	1·8	24·00

During the past five years the yearly figures of price per cwt. of cocoa were :

	Rs.
1931	30·00
1932	27·00
1933	23·00
1934	22·00
1935	19·00

A change for the better has taken place and a report issued from London at the end of June that the market was in a healthy condition and demand was rapidly increasing. The value of exports for the first half year of 1936 was Rs. 25·37 per cwt.

The market in Colombo on 6th July was Rs. 38·47 per cwt. for Estate No. 1 Cocoa. On the same date the produce of small holders was receiving offers at Katugastota, which is an important marketing centre for these crops, of Rs. 40·00 per cwt.

5. THE EXAMPLE OF NIGERIA

There is urgent necessity for Ceylon to consider the position of her cocoa industry and adopt measures to better conditions of business at every stage from the crop on the land to the produce in the warehouse awaiting export.

The methods adopted in Nigeria, an account of which is detailed in the report of the Agricultural Adviser to the Secretary of State for the Colonies, Mr. F. A. Stockdale, extracts of which are published in this journal, may well be taken as a guide to Ceylon. It was as late as 1928 that produce export regulations were framed to regulate the quality of cocoa exported from that country. The produce is inspected by a special staff and graded into three classes, and all cocoa which does not come up to the standard of Grade III is prohibited export except under special permission. Merchants were unanimous in their support of the scheme and one at least stated that it had done more for the trade of Nigeria than any other measure. It appears that the actual value of this service to the producers was not less than £100,000 per annum.

A further step towards encouraging the production of first grade cocoa is the establishment of co-operative cocoa associations. In 1934-35 according to the report there were 6,277 members of such societies who sold 2,189 tons of cocoa which commanded an average price of £1.18s. 9d. to £3. 15s. per ton equivalent to Rs. 9·36 to Rs. 24·75 per cwt. increase in price.

This system has proved of value up to a point, but there are other complications in any scheme of co-operation and it is considered in the report that the next advance should be in providing credit facilities to members of societies in order no doubt to prevent the mortgaging of crops to petty traders who, as in Ceylon, accommodate cultivators in matters of finance.

6. ASSISTANCE IN MARKETING IN CEYLON

Attempts are being made in Ceylon by the Commissioner of the Marketing Board to assist peasant cultivators in the disposal of their produce to greater advantage. Agents of the Board at several centres collect the produce in small lots and these are conveyed by a special transport service to Colombo where more favourable prices are obtained for the grower. In the first attempt occupying a period of 3 months which however did not include the main harvest season, a total of nearly 7 tons of cocoa was consigned under this scheme to Colombo. Proceeds realised were Rs. 2,263·67 while overhead charges amounted to Rs. 259·14 or 11 per cent. The average price per lb. of cocoa paid to the producers was 14 cents as against the usual price paid by local dealers of from 14 cents to 10 cents.

The scheme will be worked again next season after which it is hoped that a co-operative marketing society among growers will be formed.

7. THE STATUS OF THE PEASANT CULTIVATOR

That peasant cultivation demands a measure of special consideration and attention when the wider question of the position of the Ceylon cocoa industry receives consideration is supported by the facts that it accounts for only a little less than three-fourths of the acreage under this crop and produces probably 56 per cent. of the annual exports valued approximately at Rs. 1,000,000.

Based upon the average figures for the period 1931-1935, and an average yield of 3 cwt. of cured cocoa per acre, estate produced cocoa from 10,000 acres at a yield of $3\frac{1}{3}$ cwt. would account for 33,000 cwt. which at Rs. 24·00 per cwt. will have a value of Rs. 800,000. Peasant produced cocoa from 25,000 acres at a yield of $1\frac{3}{4}$ cwt. would account for 42,000 cwt. which at the same average value will be worth Rs. 1,000,000. The figures for 1931-1935 were :

Average exports per annum	..	75,000 cwt
Average value of exports	..	Rs. 1·8 million
Average value per cwt	..	Rs. 24·00

CHEMICAL NOTES (15)

ANLYSIS OF *PENTADESMA BUTYRACEA* (TALLOW OR BUTTER TREE) SEED

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THE oil is obtained from the seeds of the tree known as the Tallow or Butter tree (*Pentadesma butyracea*) which is a native of Tropical Africa. A few of these trees have been planted in the Royal Botanic Gardens, where they fruit freely and heavily every year. The seeds contain a fairly high percentage of oil which can be used in soap making or candle manufacture after suitable treatment. A sample of seed was sent by the Curator, Royal Botanic Gardens to the Chemical Laboratory for the extraction and analysis of the oil.

The seed is large and oval shaped and resembles a yam in appearance. It is enveloped in a fibrous covering which can be peeled off very easily. The kernel is fairly hard and leathery and the flesh is yellowish white with a pink border. The seed on the average weighs about 23·5 and 21·7 gms. before and after peeling respectively. About nineteen cleaned seeds go to make a pound.

The fat, as extracted by means of petroleum ether in a soxhlet apparatus, is of a pale yellowish colour. It compares favourably with a sample from Southern Nigeria analysed at the Imperial Institute, London in yield as well as chemical characteristics. The comparative analyses of local and foreign samples are shown in the table below.

SEED ANALYSES

	Ceylon		*Southern Nigeria*
	%		%
Moisture on air-dry seed ..	9·15	..	10·6
Fat on air-dry seed ..	39·7	..	40·0

OIL ANALYSIS

	At 45°C.	At 15·5°C.
Specific gravity	0·9128 ..	0·857
Acid value	2·8 ..	3·1
Saponification value ..	187·9 ..	186·0
Iodine value (Wijs) ..	44·3 ..	46·5
Refractive index at 35°C. ..	1·4639 ..	—

The fat will have to be extracted by chemical solvents or hot expression and must be refined for soap making. If available in large quantities, it would probably find a market in England, but whether it would be economic to export it would depend on the price it would fetch. Some years ago the kernels were valued at £8 to £10 per ton but the present price would probably be lower due to a glut in vegetable oils on the market. The fat may however find some use locally in soap manufacture.

STANDARDIZATION OF PRODUCE—COCOA*

PRODUCE INSPECTION

ATTEMPTS to regulate the quality of produce exported from Nigeria date from 1926, when regulations were framed for controlling the quality of cotton exported from the country. These regulations provided for the establishment of defined markets for the examination, grading, sale and purchase of seed cotton to be ginned for export.

In July, 1928, produce export regulations were framed to regulate the quality of palm oil, palm kernels, and cacao exported from the country and, with amendments made later in 1928, 1929, 1930, 1932 and 1933, are still in force.

The inspection procedure for palm kernels, palm oil, and cacao was examined at a number of centres. In all cases of inspection of palm kernels and cacao the produce has to be spread on a clean floor of tarpaulin before sampling is done. It is then thoroughly mixed and samples are taken from the top, middle and bottom of the spread produce. These are then thoroughly mixed in a bag, quartered, and one quarter of the first lot is mixed again in a smaller bag and from this the final sample is drawn.

In the case of cacao a sample of 20 oz. is taken, from which 300 beans are cut for examination. The beans are cut and the percentage of defects ascertained. According to these percentages the cacao is graded. The present grades for Nigeria cacao are as follows :

Grade I.—Cacao which is thoroughly dry and contains (*a*) less than 5 per cent. by count of mouldy, weevily, decayed, " flat " and/or germinated beans, and (*b*) less than 5 per cent. by count for unfermented and/or insufficiently fermented beans and is free from smoky or hammy beans.

Grade II.—Cacao which is thoroughly dry and contains (*a*) less than 8 per cent. by count of mouldy, weevily, decayed and/or " flat " beans, and (*b*) less than 5 per cent. by count of mouldy beans and is free from smoky or hammy beans.

Grade III.—Cacao which is thoroughly dry and contains less than 20 per cent. by count of mouldy, weevily, decayed and/or " flat " beans, and is free from smoky or hammy beans.

*Extracted from *Report by Mr. F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies on his Visit to Nigeria, Gold Coast and Sierra Leone. October,* 1935-*February* 1936 published in May, 1936.

Grade I is designated by a one crown mark on the bags, Grade II by two crowns and Grade III by three crowns. Any sample of 300 beans which weighs less than $10\frac{1}{2}$ oz. is designated " Light Crop Cacao " Grade I, II or III as the case may be, and all bags containing it are marked with the letters L. C.

All cacao which has passed inspection is sealed with two lead seals one at either end of the string which closes the mouth of the bag, and all cacao which does not come up to the standard of Grade III is prohibited export except under special permission. This permission is only granted when it can be shown that the defects in the consignment were due to causes which were beyond the control of the possessor of the cacao.

Merchants in Nigeria with whom produce inspection was discussed were unanimous in their support of the scheme. One stated that it had done more for the trade of Nigeria than any other measure which had been introduced. In the experience of this individual, shell in palm kernels had formerly amounted to 35 per cent., wet and mouldly cacao was common, and palm oil was watered and full of sand and impurities. I was informed that the merchants had themselves attempted to effect improvements but without result. Two years after the inauguration of the Government inspection scheme a remarkable change had taken place, and it is noticeable even then that if there is any relaxation in vigilance on the part of the examiners and inspectors a fall in the quality of the produce tendered takes place, as the sellers are past masters in presenting produce which is just on the border line of requirements. The competition between middlemen is also very keen, and they are all ready to take a chance if they think that there is any slackness in regard to the examination of produce.

Trouble is still experienced in regard to wet cacao and during 1934 a total of 1,749 prosecutions had to be taken in regard to this. A determined effort is being made to eliminate wet cacao and, although certain difficulties are experienced if weather conditions during the harvesting season are unfavourable, it is to be noted that the percentage of Grade I cacao is gradually going up. A difference of 15s. per ton was being paid during the time of my visit in favour of Grade I cacao over Grade II and the difference in value between Grade II and Grade III was 5s. per ton.

The inspection staff consists of two senior inspectors and eleven inspectors with two hundred and forty examiners. Of the latter some are permanent officers, but others are employed from season to season on a temporary basis.

CO-OPERATIVE MARKETING OF COCOA

With the object of encouraging the production of first grade cacao, co-operative cacao associations were established. In some areas the producers

preferred to form a number of small societies, whilst in others larger societies with several branches were favoured. In 1934-5, there were 6,277 members of co-operative marketing societies, and they sold 2,189 tons of cacao which commanded an average of £1 8s. 9d. to £3 15s. per ton increase in price above that obtained for F. A. Q. in the district concerned. The greatest improvement in the quality of cacao produced has been effected in the Cameroons, but considerable support of the movement has also been secured in the Oyo Province. The societies have been encouraged to form themselves into marketing Unions, and I was able to visit with the Registrar of Co-operative Societies, the Director of Agriculture and some of their officers, small village societies and the Co-operative Union of Ibadan. This Union has rented a store at Ibadan which is open to receive cacao from its affiliated societies twice weekly, and it makes a charge of 6d. per cwt. to meet the costs of marketing. The societies have to pay the transport costs to the Union's store, but it has been arranged for the Union to make this payment as an advance if necessary. The cacao, as received from the several societies, is checked as to quality and, if satisfactory, it is then weighed a receipt being given to the society's representative. The cacao accepted during the day is bulked and, when the collection is completed, the bulk is inspected in the usual manner by a produce examiner and a certificate of inspection showing the percentage of defective, slate, fermented, flat beans, mouldy, weevily, germinated, mouldy and weevily, mouldy and germinated, weevily and germinated, and mouldy, weevily and germinated beans, together with the weight of 300 beans and the percentage which on cutting is found to be damp. is given. This certificate of examination is attached to the tender notice which is sent round to buyers and is eventually filed in the records of the Union. Tenders are received in sealed envelopes and these are opened by the President of the Union—the highest tender being invariably accepted by the Committee. The time of the receipt of each tender is noted so that priority may be given to the one received first if two tenders quote the same price. Delivery is made the following day for cash and this cash, after the deduction of the Union's charge of 6d. per cwt. and any advances which may have been made for transport expenses, is paid over to the secretaries of the societies concerned and the members who are required to accompany them. A Secretary is expected to bring with him the books of his society and these are checked against those maintained by the Union as each transaction is completed.

Meetings of the Union are held fortnightly, each affiliated society being entitled to send in two members. Consideration is constantly being given to measures which would tend to improve the methods of organization, and a number of possible improvements were discussed with the Registrar of Co-operative Societies. There is some disloyalty amongst the members of societies and occasionally in the attitude of the societies to the Union. These disloyalties are mainly due to crops of cacao being pledged to middlemen during the inter-crop season and could most probably be overcome if the societies

were in a position to finance their members by means of loans. Advances up to 50 per cent. of the value of the member's crops would go far towards removing some of the present-day difficulties of producers and to win from them a greater loyalty to their societies. As in the Gold Coast, it was clear that the next advance in co-operation should be in providing credit facilities to members of societies, and the possible developments in this direction are at present being closely studied by the Registrar. Improvements in the numbering of receipts and in providing an effective system of cross checks between the books of societies and of those maintained by the Union should also be possible. Consideration should also be given to the manner in which tender notices are issued in order to ensure that no firm is unduly favoured as against another in respect of the time of receipt of the notice. This difficulty might be met by changing the order in which the firms are visited when the tender notice is sent out and an improvement might be effected by fixing a time before which tenders would not be received as well as the limit of time at present given.

The Registrar of Co-operative Societies is concentrating at present on the cacao societies in co-operation with agricultural officers, and expects later on to take up the position of the palm oil societies. A new Co-operative Ordinance (No. 39 of 1935) has recently been passed and the registration of societies will now be proceeded with. The work which has been done by the Department of Agriculture in connection with these bodies has resulted in a live interest being awakened in the possibility of developing co-operative organizations for marketing and credit purposes and, except for disappointment expressed against the small difference between the price for Grade I and Grade II cacao, members seemed to be satisfied with the work their societies are doing for them. The movement has clearly demonstrated that first grade cacao can be produced even if it is fermented in small lots, but it is clear, as has been stated above, that consideration will have to be given to the best means for providing inter-crop advances to producers if the co-operative movement is to expand materially.

During the past five years there has been a world movement towards standardization of agricultural products. It has been recognized that it is a fundamental principle of the modern commercial system, and it has been proved that a high degree of standardization can, in practice, be achieved in the course of marketing. Standardized produce goes a long way towards selling itself and every country which values its reputation avoids the exportation of consignments of produce of mixed or inferior quality. This can be avoided if the buyers decline to purchase low-grade produce or decide only to ship low-quality produce separately and under separate grade marks.

The results to be achieved from any system of inspection and grading should be an improvement in the preparation of the product and the realization of better prices. That these results have been achieved by the system in

operation in Nigeria there can be no doubt. In the western provinces of Nigeria the proportions of the different grades of cacao during the past three years have been as follows :

Year	Total main crop Tons	Percentage of Grade I.	Grade II.	Grade III.
1932-3 ..	.. 53,650	.. 18	.. 72	.. 10
1933-4 ..	.. 47,550	.. 17	.. 73	.. 9
1934-5 ..	.. 56,200	.. 27	.. 68	.. 5

The differences which were being paid at the time of my visit to Nigeria (November, 1935), between Grades I and II were 15s. per ton, and 5s. per ton between Grades II and III. Wider margins were expected as the season advanced.

Merchants in Nigeria were emphatic as to the value of produce inspection, and it was stated to me that no Government action had done so much for the country as its introduction. I was also informed in several commercial circles that any relaxation in the severity of inspection was immediately followed by a fall in quality because the producers were past masters in presenting produce which was just on the border-line of the requirements.

Merchants who originally had doubts as to the efficacy of inspection has since changed their views, as they had seen the results which had been secured and they stated that they had no desire to see any change in policy. In fact, I was informed by one representative of a large firm in Nigeria that as far as merchants in Nigeria were concerned they were satisfied that it was only a question of time when Nigerian cacao would beat the Gold Coast product in quality, if the industry in the Gold Coast maintained its present system of inadequate grading.

A study of market prices shows an improvement in Nigerian prices in relation to those realized for the Gold Coast product. The difference in prices used to be several pounds per ton, but the margin has narrowed during the past three years. An analysis of trade returns for example shows that, whereas the average value of the Gold Coast crop was £2, £3, and £2 14s. per ton over that of the Nigerian crop for the years 1930-1, 1931-2 and 1932-3 respectively, the difference was only £1 per ton in 1933-4 and £1 18s. in 1934-5. In the latter year much of the Gold Coast crop was held until late in the season, when an advance in prices occurred. During the present season the difference in values is not expected to be in excess of £1, per ton, and it is admitted by manufacturers that Nigerian Grade I is at present equal, if not superior, to Accra "fair fermented," and in the opinion of some buyers it is equal to Accra "good fermented."

The voluntary inspection scheme in the Gold Coast initiated by the Department of Agriculture, with the co-operation of merchants, demonstrated, as has been said previously, the mixed character of the shipments of Gold Coast cacaa, and led to many of the merchants themselves establishing a definite

system of inspection prior to purchase. Many of the persons formerly employed by the Department of Agriculture as inspectors under the voluntary inspection scheme are now employed by merchant firms, and there is no doubt that there has been a movement towards the establishment of marks of cacao conforming with definite market standards. It is upon this movement which has been adopted by the merchants themselves that attempts should be made to build up an efficient and controlled system.

Need for a Government controlled system.—This movement of the cacao buyers towards grading is undoubtedly in the right direction, but little is known by the producers of the action which is being taken by the buyers of their cacao. A standard price is being paid for all cacao, and the producers are quite unaware of the grade in which their cacao is being placed by the buyers for the purpose of export.

Unity of plan and unity of execution are essential to any scheme for the standardization of agricultural products, and it is for this reason that many countries of the world have in recent years found it necessary to introduce inspection, grading and even marketing schemes. The Gold Coast can be no exception to this rule, and, despite the opposition of the buyers to suggestions for a Government grading scheme, I am satisfied that it would be in the best interests of the country to take steps for its inauguration, especially if it can be built up satisfactorily on the systems which have been adopted by the merchants themselves. I recognize to the full that Government action, without the support of the producers and of the buyers, would bring about a number of difficulties, but I feel convinced that the producers if they can be instructed as to the ultimate objective of the scheme will give it their support and that buyers, once they have survived the first shock of interference in a trade which they have built up by individual effort, will co-operate in making a Government controlled grading scheme effective.

Standards of Grades.—In deciding upon any system of grading, it is necessary to take into consideration the market standards for cacao which have been laid down by some Governments and commercial organizations of consuming countries. In these standards there are slight differences, but account must be taken of the standards prescribed by the Liverpool General Produce Association, the Cocoa Association of London, the London Cocoa Terminal Market Association, the Government of the United States of America and the New York Cocoa Exchange, when any system of inspection of grading is being decided upon. In Liverpool and London, cacao sold under Clause A contract must not contain more than 5 per cent. slaty beans, and not more than 5 per cent. of all other defects. Clause C, Liverpool prescribes limits of 10 per cent. slaty beans and not more than 12 per cent. of all other defects, whilst Clause C, London provides for 10 per cent. slaty beans and not more than 10 per cent. of all other defects. For Clauses B and D, the limits are as for A and C, respectively, but lower purities can be tendered, subject to price

deductions for defects in addition to those prescribed. The Cocoa Association of London provides for sales of cacao under Clause E which places no limit on slate but requires that all other defects shall not exceed 12 per cent. The London Terminal Market does not permit its members to deal in cacao containing more than 15 per cent. total defects other than slate.

Regulations made under the United States Pure Food Laws provide that cacao shall not contain more than 10 per cent. mould plus weevil, and not more than 5 per cent. mould. The New York Cocoa Exchange provides for the following classes :— Class I : Slate not more than 10 per cent. and all other defects not more than 8 per cent. Class 2 : Slate not more than 10 per cent. and all other defects not more than 15 per cent. Class 3 : Slate more than 10 per cent. but all other defects not more than 8 per cent. Class 4 : Slate more than 10 per cent. but all other defects not more than 15 per cent. Cacao with more than 15 per cent. defects other than slate is non-tenderable by members.

In providing for any system of grading, it is essential that the grade standards prescribed in the Gold Coast should comply as far as is practicable with the requirements of consuming markets and the following grades are, therefore, recommended :—

Grade I.—Cacao which is thoroughly dry and is free from smoky or hammy beans and contains less than 5 per cent. by count of slate and less than 5 per cent. by count of mouldy, weevily, decayed, flat, and/or germinated beans.

Grade II.—Cacao which is thoroughly dry and is free from smoky and hammy beans and contains less than 10 per cent. by count of slate and less than 10 per cent. by count of mouldy, weevily, decayed, flat, and/or germinated beans (of which defects not more than 5 per cent. by count are mouldy beans).

Grade III.—Cacao which is thoroughly dry and is free from smoky and hammy beans and contains less than 15 per cent. by count of mouldy, weevily, decayed, flat, and/or germinated beans.

SOIL EROSION*

IN an address upon agricultural development in the tropics, which was given at the annual meeting of the Empire Cotton Growing Corporation in 1929, I referred to the importance of the subject of soil erosion. Attention was drawn to this in *The Empire Cotton Growing Review* for October, 1929, and I have now been asked to contribute a short article summarizing the efforts which have been made in the Empire during the past five years to deal with this problem.

In the address mentioned above, I referred to conditions obtaining in Ceylon, where for a number of years endeavours had been made by the Department of Agriculture to arouse public opinion as to the seriousness of soil erosion in that Colony, and to the need for the adoption of protective measures. To any visitor to Ceylon during the monsoon rains, the waters in the rivers present ample evidence of the amount of soil which is annually lost. From 1873 onwards the attention of the Government had been constantly drawn to the losses which were being continuously incurred from soil erosion, and in several reports the seriousness of the problem was emphasized. Numerous recommendations for dealing with it were made, but few, if any, of these recommendations were adopted.

It had not been sufficiently realized in Ceylon that, as has been so aptly put recently by General Smuts in connection with a soil erosion campaign in the Union of South Africa, "there is only one solution, and that is the *education* of public opinion". South Africa today has vast areas of mountainsides which are bare rock, thire overlying soil having been washed out to the sea. With the loss of this overlying soil, floods have become more severe. Legislation can effect some improvement in the control of soil erosion, but it is likely to be insufficient because any law is effective only when the people of the country concerned are in the state of mind to carry out that law. The Union of South Africa has been fully aroused to the fact that there must be insurance for the future, that a policy must be evolved to protect the interests of the country as a whole, and that no more constructive avenue of employment could be found for unemployed persons than the utilization of their services on reclamation work as part of a soil erosion campaign subsidized by the State.

Little real interest was taken in the question in Ceylon until about 1923, when a determined effort was made to arouse public and "planting" interest.

* By F. A. Stockdale, C.M.G., C.B.E., Agricultural Adviser, Colonial Office in *The Empire Cotton Growing Review*, Vol. XII, No. 1, January, 1935.

Visitors to Java had been impressed by the steps which were being taken in that country to preserve its soils from erosion, and the propaganda campaign which was then started met with a ready response from all classes of agriculturists. A Committee on Soil Erosion which reported early in 1931 stated that the successful propaganda work which had been done by the Department of Agriculture had been fruitful in stimulating agricultural interest in soil erosion, and in leading tea and rubber plantations to experiment in the use of cover crops, in new methods of opening land, and in modifying drainage systems. This Committee visited all parts of Ceylon and reported that a marked change in agricultural methods and outlook had taken place. It felt that the agriculturists of Ceylon were to be congratulated on the useful work of soil conservation which had been effected during the previous five years. It also commended the Department of Agriculture for the investigational and research work which it had undertaken, and suggested that the newly-formed research organizations for the tea, rubber and coconut industries should be asked to regard the problem of soil erosion as of the greatest importance, and to organize systematic investigational work in collaboration with the Department of Agriculture. The depression in the tea and rubber industries during the years following 1931 was, however, responsible for a reduction in the efforts to cope with the problem of soil erosion, but it is to be hoped that now that more prosperous days have returned, estate owners and superintendents will redouble their efforts to control the waste of their capital assets—their soils—and that the Ministry of Lands and Agriculture will take a leading part in the propaganda which is necessary to educate public opinion in a persistent demand for soil erosion control.

The prevention of soil erosion is now recognized as being one of the most important agricultural problems in many parts of the world. The experience of older countries can be relied upon for serious warnings as to its effects, and the valuable lessons which can be learned from southern European countries should not be overlooked. The deterioration of considerable areas of land in some of the Greek islands where terracing has not been adopted, is apparent whilst, on the other hand, the elaborate terraces to be found in Southern France, Italy and Sicily command admiration. The care which is devoted to terracing in olive groves and vineyards in Italy is most commendable, and one cannot refrain from wondering what changes in the methods of opening tea and rubber estates on hilly lands in the East would have been made had the pioneers been conversant with the methods used for the preservation of soils in southern Europe.

The wastage of soil which has occurred in the United States of America, and the efforts which are being made to check further loss, are now well known. The example of Japan in its measures for the preservation of soil, forest and water resources, is being appreciated, and in Java it is provided that forest lands can only be opened in economic crops if adequate contour drains are established and terraces made before planting begins.

During the past few years it has been recognized that the soil erosion problem in any country must receive nation-wide consideration, and special attention is now being given to it in a number of countries in the British Empire. A standing Committee has been set up in Tanganyika—on which the Agricultural, Veterinary, Geological, Forestry, Public Works and Railway Departments are represented—to study the problem of soil erosion and make recommendations as to work which should be undertaken to check its effects. It has as its Chairman the Director of the East African Agricultural Research Station at Amani. In Nyasaland soil erosion is being taken seriously, and sound preventive works have been undertaken there, and also in Southern Rhodesia and Basutoland. The seriousness of the problem in some of the native reserves in Kenya has been recognized, and a careful study of the factors which are responsible has been commenced. In the Seychelles, a scheme for the reafforestation of the hilltops of Mahé, one of the granitic islands with high rainfall, has been sanctioned. In the native reserves of Northern Rhodesia it is also recognized that soil erosion is going to be one of the important agricultural problems of the future, whilst the Union of South Africa has recently launched a campaign to render financial assistance to local authorities and land owners for measures against soil erosion, and to combat it in the native reserves. The estimated cost of the work to be undertaken in the reserves during the next five years is £100,000, and one of the principal objects of this campaign is to ensure the preservation of the chief watersheds of the principal rivers of the Union. During the first five months of its operation 100 miles of embankments and 200 dams have been constructed in the native reserves.

In cotton-growing areas in Africa, the dangers of soil erosion have been recognized. At the Cotton Experiment Station at Makwapala in Nyasaland, for example, erosion became so serious that three years after its opening it became necessary to ridge-terrace the whole Station. Again, at the Serere Experiment Station in the Eastern Province in Uganda a certain area suffered so severely from sheet erosion that after twenty years little soil was left. The area had been eroded to the sterile subsoil which was practically unproductive. New areas had to be opened for experimental work and a change in the system of agriculture introduced.

In certain areas of Uganda and Tanganyika pressure of population has led the inhabitants of their own volition to apply preventive measures, and cultivation methods are not always responsible for erosion. The greatest damage to be seen in Tanganyika and Kenya is in areas where relatively little cultivation is practised. Areas which are overstocked—and there are many of these in East Africa—suffer severely. In such districts all grazing is eaten down "to the bone" and in many the grasses are torn up by the roots. The whole countryside is not only overgrazed but it is grossly overtrampled, especially during the dry season. This reduces the soil to a powder which is either blown by the wind or washed away with the

first rains. As soon as the grasses "spring" after the first rains they are ravenously devoured, and no satisfactory growth of grass takes place to bind together the loose powdery soil and prevent its erosion. Certain native reserves in East Africa are showing the effects of serious damage from overstocking, and the danger to the tribes affected is a real one.

In West Africa the effects of soil erosion are as yet relatively unimportant. Here the farms are still small and cultivation on mounds or ridges is general.

In Northern Rhodesia the traditional native agricultural system was similarly in small farms cut out of the bush, but, with the introduction of ploughs, there has been a piecemeal departure from this system towards an imitation of the European farm. Erosion from small holdings of two to three acres in extent is insignificant, particularly if these are cut out of dense bush in which large numbers of tree-stumps are left, but the loss of soil from ploughed farms of ten to twenty acres in extent, which have been established in open country so as to avoid the cost of stumping, is considerable. In the course of this transition, ploughing is frequently done up and down the slope, certain traditional crops abandoned, and other recognized native methods of cultivation changed. For example, the growing of finger millet has been abandoned for maize and the greater millets as the bush areas have been left for the open country. Less ground nuts are being grown, and sweet potatoes instead of being planted on mounds are grown on the flat. The ploughing increases the run-off of water, and there are no tree-stumps to check the flow. There is more run-off in maize cultivations than in those of finger millet, and the departure from growing sweet potatoes on mounds is a mistake. The result of these changes is that soil erosion is becoming more serious, and some alteration in the system is effected devastation may result. It is not to be expected that a reversion to the traditional methods of the past will be either practicable or possible, and efforts must be directed towards building up, upon the basis of the now forsaken native methods, a system which will make continuous cultivation possible.

This problem of continuous cultivation without loss of soil fertility is one to which the Department of Agriculture in Nigeria has devoted much energy during the past fifteen years, and the results which have been obtained from systems of green manuring and mixed farming are encouraging. Cultivation on ridges as a counterpart to the traditional cultivation on mounds has been adopted. This checks soil erosion, and soil fertility is being maintained by the use of green manures or cattle manure.

In Tanganyika experiments in terracing and anti-erosion methods have been started in both European and native cultivations in the Moshi and Arusha districts, and contour planting is spreading where ridge cultivations have been started. Drainage works primarily designed to safeguard the railway have also been made to serve the purpose of soil protection.

In Nyasaland various measures against soil erosion have been adopted in the tea cultivations on undulating lands, and for tobacco and cotton lands the establishment of Mangum terraces is becoming general where ploughing is practised. This system is also commonly adopted in Southern Rhodesia. The terraces are broad-based ridge terraces of earth which are made at varying distances apart according to the nature of the soil. For clay soils, the ridge terraces are spaced so that a terrace is built for each vertical fall of 2 feet in the slope of the land, and, in sandy soils, for each vertical fall of $4\frac{1}{2}$ feet. These ridge terraces are not level, but are graded according to the slope of the land. The Mangum terraces have been found to be of the greatest value, and full particulars of their construction are given in the Nyasaland Department of Agriculture *Bulletin* No. 11 (New Series), 1934.

In Basutoland, soil erosion is being combated by the creation of a number of large shallow reservoirs in which flood waters from the hill sides can be collected. In this way the flow of water is being checked. From these reservoirs water is drawn along contour furrows for irrigation purposes, and the moisture of the soil is increased by seepage.

In the Union of South Africa anti-erosion work consists mainly of making dry stone walls and grass-covered banks along the contours. The work is always started at the top of the catchments. The stone walls have a wide base, and are 2 feet high with a horizontal crest. They are spaced at every 6 feet of vertical drop in the slope. The grass covered banks are spaced about 100 feet apart, and have openings 10 feet wide in them to prevent breaches. If the banks are required only to deal with the rainfall precipitation on the area concerned, the openings are omitted, and where the banks are continued across natural depressions, their heights are raised and their sections suitably increased. In this way, it is possible for a series of terraces gradually to be built up and a contouring of the land for agricultural purposes effected. Areas which have already been sheet eroded are being fenced and planted with cactus and salt bush. On such lands no grazing is to be permitted until some recovery has been brought about, and when limited grazing can be safely allowed, it is proposed to restrict for a while such grazing to one-third of the area and to permit it only from the time when the grasses have flowered and set seed up to the onset of the first rains.

I have endeavoured in the preceding paragraphs to give some account of the steps which are being taken in various parts of the Empire to control soil erosion. It has been shown how the measures differ under varying conditions of soil and climate. The amount of soil erosion naturally varies in degree with different methods of cultivation and on different types of soil. Measures suitable for dealing with the problem in wet areas, where permanent crops such as tea and rubber are grown, may not be suitable even for areas of lesser rainfall where coffee is grown as a permanent crop, and more certainly will not be suitable for adoption in areas where annual crops such as cotton

and cereals are cultivated. Preventive or remedial measures must be framed with due regard to the soil type, the rainfall and its distribution, and the slope of the land. They should aim at checking the velocity of the run-off and, if possible, increasing the absorptive capacity of the soil. Soils vary in their erodibility according to their capacity for absorption, their pore space, and the nature of the clay fraction.

Certain loams have a higher absorptive capacity than sands, and it is known that soils which are inclined to swell and become sticky when they are wetted, erode much more readily than soils which "walk clean" after rains. The red loams of the wetter areas of Kenya do not erode so readily as the greyer soils of the drier areas of the Colony which have a higher silica ratio. These grey soils crack when dry and are inclined to become powdery. With the first heavy rains the top layers, which are reduced to a powdery state, are washed away readily, and when wetted these soils swell and have poor absorptive capacity. The soils of Jamaica do not erode to the same extent as those of Ceylon, and it may generally be accepted that friable soils with a low silica ratio are not subject to such a marked degree of erosion as plastic soils with a high silica ratio. The subsoil condition is also of importance and should not be overlooked in any investigations of soil erosion. In Nyasaland, for example, the formation of subsoil pans or crusts is common. Some soil types also have a special tendency to compact, and this is a factor which also should not be overlooked.

In forest soils, the maximum capacity for absorption is to be found in the upper layers, whilst in cultivated arable land this is to be found in the lower levels. This is due to the compacting action on the surface soil by the direct impact of rain. Further, a natural forest soil has been shown to have an absorptive capacity fifty times as great as the same soil when under arable cultivation. This increased absorption is due to the capacity of the surface layers formed of forest debris, to take up water. Mulching with dry leaves and grass has been found in the West Indies to be most beneficial in cacao, lime and other fruit cultivations, and in certain areas under sugar-cane. In the cultivation of permanent crops it is therefore apparent that the first aim should be to maintain a satisfactory soil cover. This helps to protect the land from the compacting effect of the rain and to maintain the absorbent structure of the soil. A good surface litter on the soil is desirable if it can be secured. This not only has a high absorptive capacity but it checks the beating effect of rain and prevents the silting up of the soil pore space by the washing down of finer particles. Subsidiary measures consists of terracing, contour planting, silt-pitting, contour drains, and the growing of leguminous or other plants.

In areas devoted to annual crops the establishment of contour terraces and ridges is necessary so that they may form barriers to break the velocity of the run-off. Arable lands with annual crops suffer from erosion most

seriously because they are fallow at some stage of the cultivation and where crops can only be grown at wide intervals erosion is inclined to become worse. The amount of erosion depends greatly upon the gradient of the land, and upon whether the rainfall comes in storms or in regular showers. Anything which can be done to assist the levelling of land in a series of terraces is advantageous, and a continuous crop cover should be aimed at if possible. Local circumstances must, however, inevitably be the guide to the choice of remedies.

The soil erosion problem is still one which demands much greater attention than it is receiving even today. Areas in the upland regions of water-sheds have been and are being denuded of forests, and millions of tons of valuable soil are being carried in floods to waste. Other areas of forests have been replaced by cultivations of tea, rubber, cacao and coffee, without adequate measures to safeguard against the loss of capital assets through soil erosion. The desire for early returns has led to the adoption of measures designed to force early growth by the exploitation of virgin soils, and the dangers have as yet been insufficiently recognized.

Agriculturists in many parts of the Empire have been, and are, abandoning the traditional methods of agriculture in their countries for the extended cultivation of economic crops. Such efforts are responsible for a greater waste of soil from erosion than was formerly the case, and in certain areas may lead to its ruination unless protective measures are taken.

Overstocking is becoming general in many parts of East and South Africa, and a state of devastation may soon have to be faced in certain areas.

To all Departments of Agriculture the study of the problem of soil erosion is a matter of paramount necessity, and it is to be hoped that the efforts already made, however commendable, will be redoubled in the future in the hope of finding satisfactory solutions before it is too late. It cannot be too strongly emphasized that the real solution is likely to be found in the *education of public opinion*. This will lead to a demand for measures which at present may seem to be unattainable either because of financial considerations or of apathy amongst the growers themselves. If the seriousness of the problem is once fully realized, the adoption of remedial and preventive measures will follow.

SOIL EROSION IN TROPICAL AFRICA AND PROBLEMS CONNECTED WITH IT*

THE losses caused by soil erosion in depleting the fertility of the land is a subject which in many parts of the world has attracted much attention during recent years, but probably nowhere has erosion been such a constant menace to agricultural development as it has been in tropical Africa.

Botanic research has shown that many of the annual crops common throughout the tropics of the Old World are of African origin, such as the majority of the sorghums, the grain pennisetums, the cow-pea, sesame and, probably, the pigeon-pea and the finger-millet. Other cultivated crops are peculiar to tropical Africa, such as the Bambara groundnut and the West African species of cultivated yams and of cultivated rice. It is thus evident that tropical African agriculture must date back for thousands of years. In spite of this, the people of this region have never developed a permanent agriculture, but have always depended on shifting cultivation. There can be little doubt that this state of affairs has been due largely to soil erosion, mostly sheet erosion, which rapidly reduces the fertility of the land, when this is depleted of its natural vegetation either by cultivation or by grazing with stock.

The soils of tropical Africa are much more liable to disintegrate than are those in other parts of the tropics. There is a preponderance of sand present in most of them, and one seldom sees a soil which is sufficiently heavy to crack when it is dry. The only places where these are met with are where the finer particles, washed out of the soil by sheet-flow, have collected in low-lying areas or where these have been deposited as alluvium. Otherwise, the surface soils compared with those of other parts of the tropics are extraordinarily light and very likely to be affected by sheet-flow as well as by gully erosion. In nature the surface soil is protected by ground vegetation, but as soon as this is disturbed, either by cultivation or by too close grazing, rain causes the soils to disintegrate and erosion immediately commences.

The peoples of tropical Africa are primarily agriculturists. They can be divided into two main categories—namely, the pastoral people, who own cattle, and the agricultural people, who do not. The pastoral tribes seldom

*By H. C. Sampson, C.I.E., F.L.S. in *The Empire Cotton Growing Review*, Vol. XIII No. 1, January, 1936.

take any direct interest in the cultivation of the land, but live on their flocks and herds and on such wild plants as nature provides. They are, from their mode of living, a more aggressive and warlike people ; for they not only have to defend their stock from wild animals, but, being nomadic, they have to assert their ownership to grazing areas, waterholes, etc. As their herds have increased, they have extended their boundaries in search of new grazing areas, and have thus frequently replaced agricultural tribes. Sometimes this has been their undoing, as they have run into tsetse-fly areas, and, having lost their cattle, have been forced to become indifferent cultivators. Until the coming of the white man, the only restriction to their expansion has been the presence of tsetse-fly and the existence of high forest or other types of vegetation where grazing facilities do not exist. Thus the agricultural tribes are, as a rule, located in areas where natural grazing conditions are unattractive, and much of the area occupied by them is, or has been, fly country. Such areas include also riverside alluviums, areas where the tree vegetation is too dense for pasture grasses to thrive, areas where high coarse grass, unsuitable for grazing, dominates the ground vegetation, and areas where the rainfall is too heavy for stock to thrive. It is extremely seldom that one finds a combination of stock-raising and tillage. There are a few examples, such as the case reported by Staples, where on one of the densely populated islands in Lake Victoria the people keep cattle for supplying manure to their cultivation. Around Karonga, at the north of Lake Nyasa, the cultivating tribes keep cattle, and at Taveta at the foot of Kilimanjaro, also, a few cattle are owned. These are always kept tied in darkened huts, as it is a fly area. In West Africa from the Gambia to Nigeria the cultivating tribes, dwelling in fly areas, keep a few cattle ; these belong to humpless breeds and are said to be immune to trypanosomiasis. It is only when one gets out of the tropics in South Africa that one comes across any real traces of a combination of stock-raising and arable farming among the native tribes. Many of the agricultural tribes in tropical Africa do, however, keep small livestock—mostly goats and occasionally sheep.

Both these types of farming are responsible for erosion. In times past the numbers of cattle maintained by pastoral tribes were kept down by inter-tribal wars, stock raiding, and by disease, but European administrations have done much to destroy these agencies for restricting grazing. As far as East Africa is concerned, overstocking and consequent soil erosion have become perhaps the most serious problem of administration, and unless overstocking is checked, erosion seems likely to destroy these people whose existence is solely dependent on their livestock. In many places the grass cover of the land has now been entirely destroyed and there exists only scattered, useless ground vegetation. In the dry season the surface of the ground is completely broken up by the feet of the animals seeking for something to eat, so that when concentrated rain falls as it does in these dry grazing areas, the water, unable rapidly to penetrate the dry ground, rushes

off the surface, often carrying with it the whole surface soil. In places, conditions have become so bad that there is no possibility of the natural regeneration of the grass flora, as no grass is left to form seed for re-seeding the area. The only plants which survive are those which stock avoid, such as thorny acacias, ground succulents, *Cassia* species, etc., and these are rapidly dominating the flora of such regions, which are fast becoming deserts.

Evidence exists to show how rapid this deterioration is. Chapter X, Part III, of the Kenya Land Commission Report is devoted to this subject of overstocking, and gives numerous examples of large areas where desert conditions have succeeded what even twenty years ago were rich grazing areas. It is pointed out also that, though the numbers of cattle owned by these pastoral tribes have doubled within the last twelve years, yet such is the miserable condition of these animals that the products of this industry have actually decreased. It might be suggested that the solution of this trouble could be found in turning the attention of the people to the cultivation of the land, but as conditions now are, any such attempts would be wasted, because, when rain falls, so rapid is the run-off that water has not time to penetrate into the ground.

Much has been written about the evils of shifting cultivation in depleting the fertility of the land, but the effects of this are as nothing compared with the havoc which can be wrought by overstocking.

The agricultural tribes can scarcely be blamed for the established custom of shifting cultivation. Under the present distribution of population, these people are entirely dependent on the existing fertility of their cultivated plots, and without manure there must come a time when the land will cease to yield sufficient produce to warrant cultivation. Their resources for manuring the land are practically non-existent. They do not own livestock sufficient to produce manure, and the only method they know of manuring the land is to cut and burn the vegetation when they are making a new clearing. Thus a system has been evolved of allowing the land to revert to bush growth, so that it can recuperate, while a new area is cleared and burnt for future cultivation, till that in its turn is temporarily exhausted. Much of the surface soil of Africa being very sandy, when it is depleted of its natural cover the finer particles are very apt to be washed away or washed deeper into the ground, thus leaving the surface soil in a greatly impoverished condition. The natives, although frequently blamed by Europeans for their habit of shifting cultivation, are extremely good judges of land, and close observation will show that they do not abandon a clearing until forced by necessity to do so. Where soil conditions are really favourable one finds conditions which closely approximate to permanent occupation of the land, as, for example, on the red soils of North Kavirondo and of Kikuyu in Kenya, where the density of population is as high as it is on similar types of land in countries where a permanent and highly developed system of agriculture is in existence.

It is, however, very noticeable that the land occupied by the two tribes of these areas is strictly confined to a single type of soil. Again, on level river alluviums one finds conditions approaching permanent occupation of the land. Village sites are much more permanent and land is rested for only short periods. It often seems as if the land is abandoned more on account of too heavy a weed growth than from soil exhaustion. Such land seldom reverts to a bush fallow, as on account of continous cultivation, tree vegetation has ceased to exist, but it grows a succession of useful weeds, which appear to check the growth of the more objectionable species and thus again render the land fit for cultivation.

Bush fallows play an important part in the agriculture of these people. It really amounts to a rotation of cultivation and bush, the latter being allowed to grow so that the fertility of the land can be replenished. Tree and other wild vegetation can draw on the deeper soil levels for their sustenance, at the same time adding humus and plant food to the surface soil and checking further erosion. Although the lands of a village are generally communally owned, it is the tribal custom among many of these people to recognize the rights of individuals, and if an area has once been cleared, the native responsible for the clearing is entitled to regard that area as available for himself for future cultivation.

Even when making a clearing, the cultivator is careful not to destroy tree vegetation. Any trees in the area are either coppiced or pollarded—the practice varying in different regions—this being done to ensure that the trees are not killed. After weeding the crops, one often notices that the weeds are piled up around such trees, thus assisting them to recover from the removal of their crowns, and otherwise protecting vegetation. This must to some extent check surface wash from the cultivated plot.

Methods of cultivation also are frequently designed to check erosion. Doubtless many of these have now become customary and their origin is lost in the past. The practice of throwing the land up into mounds and of growing the crops on these mounds is common throughout tropical Africa ; sometimes this is combined with the inversion of the soil so thrown up, so that any ground vegetation is buried. This helps to hold the mound together during the first season of the clearing, besides adding vegetable matter for the formation of humus. The presence of these mounds checks the flow of surface water and allows it to soak in, instead of running off and carrying with it much of the goodness of the land. In some areas this practice has been improved upon. Instead of mounds, ridges and furrows are made along the contour, and these are broken so that each furrow catches the water that falls on the ridge and thus prevents wash. In Southern Nigeria, where there is a fairly heavy rainfall and an extended rainy season, these ridges and furrows may be quite large and involve a considerable amount of labour. In the drier parts of West Africa this ridge-and-furrow system of cultivation is

generally adopted, and the local hoes are specially adapted not only for making ridges but for inverting the soil on to the ridge. These mounds and ridges when once made are more or less permanent as long as the clearing is in cultivation, and thus they become consolidated ; all that is required is to make them up again at the sowing season. Experiments carried out in Nigeria go to show that this is a sound practice, for though these old mounds or ridges may not give quite so much produce, the cost of repairing them is very much less than would be the cost of remaking them. These few examples show that the natives fully realize the losses caused by erosion and consequent soil exhaustion, and their methods are well worth studying not only for themselves, but as a guide to those who seek to improve on them.

Such methods of shifting cultivation answer well enough as long as the population can be kept within reasonable limits. In former times the population of these agricultural tribes was kept down by raiding for slaves, and in some parts of Africa vast areas were depopulated, which have never recovered to this day. Disease also played a considerable part in checking increases in population. Small pox, for example, still levies a very heavy toll on life if no protection is afforded, and, though the African does not appear to feel the effects of malaria as the European does, there is no doubt that infant mortality is very severe from this cause. Under European administration slave raiding has been abolished and internal strife has been checked. Health services are doing much to fight disease and to change the present insanitary habits of the people, and the result which is bound to follow is an increaed and more healthy population. Already in many parts of tropical Africa the pressure of population on the land is being felt, and the tendency is for the periods of bush fallow to become shorter and shorter. In order to increase the trade and prosperity of the country, the agricultural tribes are being encouraged to grow crops for export ; thus larger areas are being cultivated than formerly were necessary when the only consideration was to supply food for local use.

An extensive literature has arisen in recent years, dealing with methods of checking soil erosion, but many of these methods are only applicable where large areas have been cleared. Some involve considerable capital expenditure and therefore have no appeal to the native, whose plot of cultivation is small and who has no title to the land which he is cultivating.

The problems, therefore, facing the administration of these countries are many. Is it possible to introduce a system of land ownership ? Is it possible to bring land under permanent cultivation ? Is it possible to create a demand for cattle both for work and for manure among the agricultural tribes, so that a valuable market can be found for the surplus stock of the pastoral tribes ? Is it possible to convert the pastoral nomad into a settled agriculturist ?

The Agricultural Department in Nigeria has been the pioneer in trying to answer some of these questions. In the southern part of that country, where the rainy season is extended and where agricultural soil exist, it has been proved that land can be kept under permanent cultivation and in a high state of production by the practice of introducing green manure crops into the rotation. The work has been summarized in a Bulletin issued by the Department (*3rd Spec. Bull. Agri. Dept. Nigeria*, 1931) and there is no need to deal with the subject in detail here. The problem which now confronts the Department is to modify the methods employed so that they will appeal to the native. At present the additional labour involved in the cultivation of green manure crops renders it difficult to introduce these methods into native agriculture. In the dry northern parts of Nigeria such a practice is impracticable, as the rainy season is not long enough to grow a food and a green manure crop in the same season. In this region, however, cattle can be maintained, and advantage has been taken of the fact to demonstrate the possibility of small mixed farm holdings. Remarkable results have been achieved. Individual cultivators have been supplied with a nucleus stock of working and breeding cattle and provided with a suitable area of land. The manure from the stock is used to maintain the fertility of the land, and the area cultivated with the aid of the draught cattle is sufficient not only to maintain the small-holder and his family but to enable him to repay the initial cost of the animals supplied to him. Great progress has been made in establishing these holdings, and in this work the Native Administration has heartily co-operated in financing them and in assisting to stock the holdings. Here, as elsewhere in Africa, the cattle of the country are owned by pastoral tribes, who, in the first instance, showed the usual disinclination to part with their animals ; now, however, they are finding a ready market at remunerative prices for their surplus stock. The striking feature about this work is that the interests of the individual are the primary consideration. In other parts of Africa the introduction of ploughs and the utilization of cattle for ploughing have been an important part of the work of Agricultural Departments, but there is nothing to show that any attempt has been made to utilize their introduction to improve the individual status of the people and to render the land cultivated permanently suitable for cultivation. In fact, the rapid increase in ploughing and in the area ploughed is in some places causing alarm. It merely enables larger areas to be grown temporarily with commercial crops, and the inevitable result is more serious soil erosion and a shortening of the period of bush fallow.

The introduction of draught cattle into the agricultural practice of Africa must, however, be a slow process. At present it is only feasible in areas free from tsetse-fly, but as the work of exterminating the fly progresses, doubtless new areas will become available. Probably the only method of preventing them from again becoming fly-infested areas is the development of a native system of mixed farming. One finds that in areas where there is

now dense European settlement, and which were previously fly-infested, the fly has now disappeared, and the same result is probable if the problem of settling natives on cleared areas is tackled in the right way.

If the benefits which tropical Africa derives from European influence are not to be ephemeral, the present exploitation of the fertility of the land, whether by agricultural or pastoral tribes, must be checked. Research should concentrate on problems such as those briefly referred to in this article, and the closest co-operation possible between the Departments of Agriculture and Animal Husbandry and the Administrative Service must follow if the results of such research are to be of any material value in checking the huge capital losses now being incurred.

THE SOIL EROSION QUESTIONNAIRE—1935*

MALCOLM PARK, MYCOLOGIST

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IN 1929, as a result of agitation by those interested in the agricultural welfare of the Island, a committee was appointed to consider and report on the question of soil erosion in Ceylon. The Committee, of which the Director of Agriculture was Chairman, consisted of representatives from the Ceylon Civil Service, the Forest Department, the Survey Department, the Irrigation Department and the planting community. It is generally agreed that the work of the committee was extremely thorough and the report published in 1931 an excellent one. The recommendations of the committee, embodied in Chapter V. of the report were, briefly, that the need for the extension of anti-soil erosion measures in Ceylon was great ; that much could be done by the extension of the propaganda work already carried out by the Department of Agriculture and by progressive agriculturists ; that the clearing of land by Government Departments should serve as an example to others of the correct application of methods of soil conservation ; and that, although the Committee was at first unanimously of the opinion that Government interference was called for, it felt that, until the possibilities of propaganda, persuasion and example had been exhausted, it was not desirable to recommend Government interference with private property. The report went on to say :

> " The Committee considers, however, that after educative methods have been tried for a limited period, say five years, or, if the present depression continues, seven years, the subject should be brought up for review on the understanding that, if conditions are still unsatisfactory, compulsion by means of legislation should be further considered."

The question of soil erosion was again raised at the meeting of the Central Board of Agriculture held on 13th September, 1934. After an interesting discussion the Board decided that its Executive Committee should go into the question and consider ways and means of implementing partly or wholly the recommendations made in Chapter V. of the Report of the Soil Erosion Committee.

The Executive Committee considered the matter at a meeting held in November, 1934 and decided that before recommendations could be framed it was desirable that data should be obtained to show what progress with measures of soil conservation had been made since the publication of the Report of the Soil Erosion Committee. To this end a circular letter was

*The above is a revision of the article which appeared in this Journal, Vol. LXXXV, No. 6, Dec., 1935, pp. 369-380.—*Ed.* T. A.

sent to the Planters' Associations and to other organizations interested in agriculture asking for information. The answers to this circular letter proved to be unsatisfactory and a questionnaire was drawn up. Details of the questionnaire are given below :

SOIL EROSION QUESTIONNAIRE

1. Name of Estate :

2. Planting District :

			Acres
3. Acreage under	(i)	Tea	
	(ii)	Rubber	
	(iii)	Coconuts	
		Total ..	

4. (*A*) Anti-soil erosion Measures taken :	On old areas: Prior to 1931	Measures taken in 1931	1932	1933	1934
(*a*) Drains.—					
(i) Level, contour or regraded drains ..					
(ii) Lock and spill drains ..					
(iii) Reverse slope drains ..					
(*b*) Silt-pits ..					
(*c*) Contour terraces ..					
(*d*) Contour platforms					
(*e*) Contour planting (*i.e.*, of the crop)					
(*f*) Contour hedges of green manure plants ..					
(*g*) High shade ..					
(*h*) Low shade ..					
(*i*) Ground cover crops ..					

(i) Introduced (not naturally occurring).

(ii) Naturally occurring (including weeds and grasses)

4. (*B*) Same questions as above, for new clearings (opened since 1930)

5. Do stray cattle cause any damage to ground cover crops on the estate ?

6. Do you still use scrapers ?

Copies of the questionnaire were sent to about 1,200 estates, through the courtesy of the Planters' Association of Ceylon and of the Low-Country Products' Association, to the Tea Research Institute, the Rubber Research Scheme, the Coconut Research Scheme and to the six Divisional Agricultural Officers of the Department of Agriculture. Where more than one crop was grown on an estate, superintendents were asked to use a separate form for each crop, provided that the extent exceeded ten acres. Approximately 1,000 completed forms were received.

In analysing the answers to the questions certain difficulties were at once apparent. The total areas on which soil conservation measures had been undertaken were not always given. It is a common practice on estates to lay down more than one soil conservation measure on the same land ; for example, contour hedges of green manure plants are often planted in conjunction with contour drains. It was therefore sometimes possible when analysing returns to obtain only an estimated figure for the total area treated, but it is thought that errors so introduced are not great.

Drains.—The figures given for the area under level, contour or regraded drains (Question 4(*a*) (i)), must be accepted with a certain amount of reserve. The term " contour drains " has, unfortunately, not been taken literally by all who have answered the questionnaire as it is customary for some planters to refer loosely to any lateral drains, which may have a slope of 1 in 30, as contour drains. It was found impossible to delete every answer in which this mistake was made, although this was done when it was clear from personal knowledge that a mistake had been made.

The answers to questions 4(*a*) (ii) and 4(*a*) (iii) are probably correct as the terms are well understood.

Silt pits.—It was the intention, when the questionnaire was framed, to obtain figures for the area in which were dug adequate silt pits such as those of the type known as Java silt pits, which are shown in Fig. 17 of the Report of the Soil Erosion Committee. The answers to the questionnaire indicated that this interpretation had not been adhered to and, as it was felt that many of the silt pits classified have but little value as measures for soil conservation, the answers to this question have not been included in the summaries which are now printed. Moreover, in measures such as lock and spill drains and contour platforms silt pits play an integral part and it was felt that an unnecessary duplication of figures might lead to a fictitious appreciation of the situation.

Contour terraces, platforms, planting and hedges of green manure plants.—The answers to questions 4(*c*), 4(*d*), 4(*e*) and 4(*f*) appear to have presented no difficulty and have been accepted as received.

TABLE I

TEA

Planting District	No. of Ests.	Total Area	Measures Taken				No. of Ests. dam-aged by Cattle	No. of Ests. using Scra-pers
			Before 1931	Since 1931				
			Old Areas	Old Areas		New Clear-ings Acres		
		Acres		New Work Acres	Super-imposed Acres			
Alagalla	5	1,670	1,260	5	—	5	—	3
Ambegamuwa	8	3,576½	1,777¼	564½	—	66	2	8
Badulla	37	25,116½	15,417	2,631	1,210	269	10	29
Balangoda	10	5,038¼	2,667	1,081	—	476¾	3	9
Bandarawela	1	298	35	263	—	—	1	—
Dickoya, Lower	1	606	594	—	540	12	—	1
Dickoya	60	19,778	12,747½	5,808½	4,290¾	20½	1	48
Dimbula	78	35,801¼	17,546¼	7,263	2,854½	160½	3	62
Dolosbage	16	7,854½	3,765¾	1,360¾	105	119¾	3	14
Galagedera	1	190	3	183	—	—	—	1
Galle	8	2,439½	1,751¾	—	50	125	2	5
Galaway, New	2	826	826	—	44	—	—	1
Hantane	8	4,367½	1,195	1,456½	—	2½	—	8
Haputale	29	18,358½	9,888½	2,308½	1,343½	84½	1	20
Haputale, West	2	451	451	—	—	—	—	2
Hewaheta	8	6,085	3,530½	427¾	614	40½	4	7
Hewaheta, Upper	1	928½	—	928½	—	—	—	1
Hewaheta, Lower	1	914	—	—	—	25	—	1
Hunasgiriya	5	3,289¼	769	1,256	—	136	2	4
Kadugannawa	6	1,881¾	1,696¼	—	—	4½	—	6
Kandy	5	1,592	1,494	16	—	—	1	5
Kalutara	10	4,243¾	2,878	131	—	34	2	6
Kegalle	7	3,013½	2,378	14½	200	95½	2	6
Kelani Valley	9	3,020¾	1,242¾	58	200	78½	5	5
Kelabokke	7	3,837½	1,871	597½	—	4½	—	7
Knuckles	10	5,067½	4,073½	599½	493	—	2	9
Kotmale	8	5,518½	775	1,092	—	155	—	8
Kurunegala	1	200	82	—	—	—	—	—
Madulsima	9	8,045¾	4,766	1,035	—	195	—	7
Maskeliya	33	15,186	4,467	2,997	469	27	—	28
Matale, East	14	5,541¾	2,446	1,179	772	26½	3	13
Matale, North	4	948¼	235½	503	—	17¾	3	2
Matale, South	8	2,662½	1,615½	—	—	30	2	7
Matale, West	2	1,079	52	548	—	64	—	2
Matara	1	728	—	—	—	—	—	1
Maturata	10	6,022	893	1,843½	—	11½	—	9
Medamahanuwara	2	778	45	82	—	14	1	2
Moneragalla	1	348	—	348	—	—	—	1
Morawak Korale	8	3,397½	1,751	790½	60	207	1	7
Nilambe	8	4,499	462	715	83½	81½	—	7
Nuwara Eliya	11	4,616¼	975¾	2,169½	—	46	2	7
Passara	6	6,487½	2,585	1,405½	—	44½	2	6
Pundaluoya	6	3,496	2,553	25	—	3	—	3
Pussellawa	17	10,213¾	6,168	820½	—	200¾	5	17
Rakwana	9	3,909	2,699½	591½	559½	—	3	9
Ramboda	7	5,591¾	1,860	1,021	—	75½	—	7
Rangalla	6	5,005¾	3,241½	532	1,091	—	1	6
Ratnapura	26	19,577¾	10,008	2,420	170	315	7	16
Uda Pussellawa	21	10,955½	5,573	3,028½	—	165½	3	12
Wattegama	4	1,908¼	1,004¾	912	—	91	—	6
Yakdessa	1	507	—	—	—	—	—	1
	558	287,467¾	144,116¼	51,012	15,149¾	3,530½	77 (13·8%)	452 (81%)

TABLE 2

RUBBER

Planting District	No. of Ests.	Total Area	Measures Taken				No. of Ests. dam-aged by Cattle	No. of Ests. using Scra-pers
			Before 1931	Since 1931				
			Old Areas	Old Areas		New Clear-ings		
				New Work	Super-imposed			
		Acres	Acres	Acres	Acres	Acres		
Allagalla ..	4	1,278½	908½	370	87	—	2	—
Ambegamuwa ..	1	310½	310½	—	—	—	1	—
Badulla ..	9	726¼	667¼	—	—	—	1	4
Balangoda ..	2	227	227	—	—	—	2	2
Colombo ..	1	273	273	—	—	—	1	1
Dolosbage ..	8	995¾	610¾	25	—	—	4	3
Dumbara ..	2	551	—	—	—	—	—	—
Elpitiya ..	1	525	523	—	—	2	1	—
Galagedara ..	2	613	400	—	—	—	1	—
Galle ..	27	15,233½	14,945½	203	482	10	17	3
Hantane ..	3	430½	—	—	—	—	1	—
Haputale ..	12	3,736¼	2,030¾	655	250	10	6	1
Hewaheta ..	1	44	44	—	—	—	1	1
Kadugannawa ..	5	1,849	874	—	42	—	1	1
Kandy ..	4	1,042	1,042	—	—	—	1	—
Kalutara ..	62	37,076¼	32,450	4½	1,666	550½	48	10
Kegalle ..	26	11,347½	9,273¾	28	—	151	15	3
Kelani Valley ..	66	38,833½	32,425¼	1,685½	—	354½	57	6
Kelabokke ..	1	10	—	—	—	—	—	—
Knuckles ..	3	389½	389½	—	25	—	2	2
Kotmale ..	2	614½	360½	—	—	—	—	—
Kurunegala ..	9	4,693¾	2,213½	251	—	224	6	—
Madulsima ..	3	193	162	—	—	—	—	1
Matale, East ..	8	2,820	2,427	370	—	8	3	1
Matale, North ..	10	5,517¾	4,410	589	—	23¾	8	4
Matale, South ..	10	2,584	1,701	220	—	—	4	4
Matale, West ..	15	7,496½	5,737½	531	—	4	13	7
Matara ..	2	1,123	793	—	—	—	1	2
Medamahanuwara ..	5	2,831	2,247	—	—	—	—	2
Morawak Korale ..	6	961	675	—	400	—	—	1
Nilambe ..	4	481	721	—	—	—	—	—
Passara ..	5	1,820	1,590¼	—	—	—	3	2
Pussellawa ..	7	767½	465½	—	—	—	2	3
Rakwana ..	6	1,654	1,082	115	—	—	3	1
Rangalla ..	2	278	278	—	—	—	2	1
Ratnapura ..	40	26,510	20,085	—	151	38	28	12
Wattegama ..	6	1,229¾	700	50	—	—	1	2
Yakdessa ..	2	952	366	—	—	—	—	1
	382	178,018¾	143,409¼	5,097	3,103	1,375¾	236 (61·8%)	81 (21%)

TABLE 3

COCONUTS

Planting District	No. of Ests.	Total Area	MEASURES TAKEN				No. of Ests. damaged by Cattle	No. of Ests. using Scrapers
			Before 1931	Since 1931				
			Old Areas	Old Areas		New Clearings		
				New Work	Super-imposed			
		Acres	Acres	Acres	Acres	Acres		
Chilaw	7	3,356	2,106	354	—	—	5	—
Colombo	1	299	299	—	—	—	1	1
Galle	1	887	887	—	346	—	—	1
Hewaheta, Upper	1	38½	—	38½	—	—	1	1
Hewaheta, Lower	1	393½	—	—	—	—	—	—
Kurunegala	13	7,202¼	4,014½	2,074½	51	34½	7	—
Matale, South	1	14	14	—	—	—	—	1
Matale, West	1	13¾	8	—	—	—	1	1
Negombo	3	815½	484	100	—	—	—	—
Nuwara Eliya	1	628	—	627	—	—	—	—
Puttalam	1	259½	—	—	—	—	—	—
Ratnapura	1	12	10	—	—	2	1	1
	32	13,919	7,822½	3,194	397	36½	16 (50%)	6 (18·75%)

Shade.—The growth of high and low shade on estates is not undertaken as a measure of soil conservation nor does the presence of such trees, unless very thickly planted, affect to any great extent the amount of soil erosion. These figures were therefore omitted.

Ground cover.—Questions (*i*) (i) and (*i*) (ii) offered no difficulty.

TABULATION OF RESULTS

The printed questionnaires were circulated in August, 1935. By the middle of October very few further replies were being received and the tabulation of answers was commenced. The answers for tea, rubber and coconuts were separated, grouped under planting districts for convenience and the details of each estate noted. It is not proposed to give here the full details of the tabulated replies from each estate owing to lack of space. The full details are available for inspection if required, the names of estates being substituted by serial numbers as a desire has been expressed that the names of estates which have supplied information should not be disclosed.

Tables 1, 2 and 3 give summaries, for tea, rubber and coconut estates respectively, of the areas of soil conservation measures undertaken, tabulated by districts. The soil conservation measures taken have been divided up into work undertaken before 1931, new work on old areas, super-imposed work on old areas, *i.e.*, where an additional measure has been introduced since 1931 into land already possessing at least one measure, and work on new clearings. One regrettable feature of the questionnaire is that provision was not made for determining the total area of new clearings. Judging by inspection of returns, however, it would appear that all new clearings in tea, rubber and coconut have been opened with at least one soil conservation measure adopted. The last two columns of these tables show the number of estates which report damage to ground cover crops by stray cattle and those which are still using scrapers for weeding.

Tables 4, 5 and 6 are summaries, for tea, rubber and coconut estates respectively, of the total areas under the different types of soil conservation measures. These indicate what progress has been made in the extension of soil conservation since the publication of the Report of the Soil Erosion Committee.

DISCUSSION

It is not proposed to discuss fully the import of the figures given in the tables which are now published, since the matter is, so to speak, *sub judice* in that the Executive Committee of the Central Board of Agriculture are at present considering the question and their recommendations may be affected by the method in which the figures are interpreted. It is felt, however, that certain general observations may not be out of place.

The financial depression, which was alleviated only in 1934, must be taken into consideration when the figures are reviewed. However much the importance of laying down additional measures of soil conservation was appreciated by agriculturists as a result of the Soil Erosion Committee's report, the financial stringency was such that most estates were unable to spend much money on new works during the period 1931-1934. The Soil

TABLE 4

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN TEA ESTATES

1. No. of Estates submitting returns 558*
2. Acreage of Estates submitting returns 287,467¾
3. Acreage of anti-soil erosion measures taken :—

	No. of Estates	Measures taken in					Total 1931-34	Grand Total
		Prior to 1931	1931	1932	1933	1934		
Drains :	370							
(i). Level, contour or regraded ..		90,025	7,951	2,432	2,191½	15,090¾	27,665¼	117,690¼
(ii). Lock and Spill		51,479	5,866¼	2,188¾	2,398¼	9,365¾	19,819	71,298
(iii). Reverse Slope		12,352¾	1,941	2,838½	2,242	2,968¾	9,990¼	22,343
Contour Terraces)		33,413¼	4,623	2,966¾	2,079½	4,590	14,259¼	47,672½
Contour Platforms >	279	1,814	601½	52	164½	440	1,258	3,072
Contour Hedges)		10,242½	2,367	2,039½	2,336	4,188¼	10,930¾	21,173¼
Contour Planting	25	4,193½	108	39	37	22	206	4,399½
Ground Cover :	226							
(i). Introduced		11,838½	3,679½	3,895¾	3,572	6,849	17,996¼	29,834¾
(ii). Natural		23,530¾	3,509	1,898	1,833½	2,724	9,964½	33,495¼
	906*	238,889¼	30,646¼	18,350¼	16,854¼	46,238½	112,089¼	350,978½

*The comparison of these figures indicates that a number of tea estates adopt more than one anti-soil erosion measure.—Ed. T.A.

TABLE 5

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN RUBBER ESTATES

1. No. of Estates submitting returns 382*
2. Acreage of Estates submitting returns 178,018¾
3. Acreage of anti-soil erosion measures taken :

	No. of Estates	Prior to 1931	Measures taken in 1931	1932	1933	1934	Total 1931-34	Grand Total
Drains :	219	75,081¾	492	134	67	558½	1,251½	76,333¼
(i). Level, contour or regraded ..		3,538	202	438	571½	1,502	2,713½	6,251½
(ii). Lock and Spill		3,055½	516	297	223	796	1,832	4,887½
(iii). Reverse Slope		73,661¾	195	180	86	105½	566½	74,228¼
Contour Terraces	189	859½	95¾	78	30	165	368¾	1,228¼
Contour Platforms		4,412	900	165	41	50½	1,156½	5,568½
Contour Hedges		3,560¾	92	92¼	71¾	68¼	324¼	3,885
Contour Planting	25	88,476½	1,064¼	1,386	1,141½	5,334½	8,926¼	97,402¾
Ground Cover:	292	20,450¼	2,090¾	740	54½	2,854	5,739¼	26,189½
(i). Introduced								
(ii). Natural								
	725*	273,096	5,647¾	3,510¼	2,286¼	11,434¼	22,878½	295,974½

*The comparison of these figures indicates that a number of rubber estates adopt more than one anti-soil erosion measure.—Ed. T.A.

TABLE 6

SUMMARY OF ANTI-SOIL EROSION MEASURES TAKEN IN COCONUT ESTATES

1. No. of Estates submitting returns 32*
2. Acreage of Estates submitting returns 13,919
3. Acreage of anti-soil erosion measures taken :

	No. of Estates	Prior to 1931	Measures taken in 1931	1932	1933	1934	Total 1931-34	Grand Total
Drains :	10							
(i). Level, contour or regraded ..		2,047	62	105	75	100	342	2,389
(ii). Lock and Spill		14	52	63	81	114½	310½	324½
(iii). Reverse Slope		—	—	5	10	15	30	30
Contour Terraces }		69	63	68	113½	107	351½	420½
Contour Platforms }	5	201	—	—	—	—	—	201
Contour Hedges }		—	113	84	164¼	144½	506	506
Contour Planting	1	80	—	—	20	—	20	100
Ground Cover:	19							
(i). Introduced		4,907	1,232	595	515½	149	2,491½	7,398½
(ii). Natural		1,098¾	—	2	107½	—	109½	1,208¼
	35*	8,416¾	1,522	922	1,087	630	4,161	12,577¾

*The comparison of these figures indicates that very few coconut estates adopt more than one anti-soil erosion measures.—Ed. T.A.

Erosion Committee appreciated this when suggesting that a period of seven years should elapse, if the depression continued, before the subject should be brought up for review.

The total areas of tea in Ceylon excluding small-holdings, has been estimated at 450,000 acres. The acreage of estates from which returns have been tabulated is 287,467¾ or about 64 per cent. of that total. The total area of estate rubber has been estimated in the Year Book of the Planters' Association for 1934, as 466,679 acres. The area from which figures have been received is 178,018¾ acres—about 38 per cent. of the total. Returns from coconut estates were received covering only 13,919 acres, which is only about 1¼ per cent. of the estimated total area (1,100,000 acres) of coconuts in Ceylon, but the area of estates is much smaller than the total area.

Tea.—In examining the figures for tea, given in tables 1 and 4, we find that, of the 287,000 acres from which figures were obtained, 144,000 acres were under one or more soil conservation measures before 1931. Since then new measures have been adopted on about 70,000 acres, but much of this area is land on which one or more soil conservation measure already existed. 452 out of the 558 estates submitting returns still use scrapers to a greater or lesser extent.

Of individual measures, the provision of soil cover is the most important. The Soil Erosion Committee stated that "the first and most important step in the control of present erosion and the prevention of future erosion is the provision of ground cover." It is noted that before 1931, 11,838½ acres of tea were planted with an introduced cover crop. Since then, approximately 18,000 acres have been planted with cover crops of which 6,849 acres were planted in 1934. Similarly, natural cover was allowed to grow in 23,530¾ acres of tea before 1931 and that area has increased by 9,964 acres between 1931 and 1934. It would appear that clean weeding is still the most common practice but that the practice of growing some form of soil cover is gaining ground.

Apart from those for new clearings, which have been affected by restriction, the figures for every measure introduced show an increase in 1934 over those for the years 1931 to 1933.

Rubber.—In considering the figures from rubber estates, is is necessary to remember that many estates have been on a "care and maintenance" basis during the period under review. In 1930, 143,000 acres of the 178,000 acres dealt with were under one or more soil conservation measures. Since then new measures have been taken on 9,500 acres, some of which are on areas on which one or more soil conservation measures already existed.

It is noteworthy that 236 out of 382 estates submitting returns report that stray cattle cause damage to cover crops.

Turning to individual measures (table 5), it will be seen that cover crops had been introduced on 88,000 acres in 1930, and that a further 9,000 acres have been planted with covers since 1930. Natural covers existed on 20,000 acres in 1930 and have been allowed to grow on about 5,700 acres more since. Adding these figures together a total is obtained of 120,000 acres under some

form of soil cover, out of the 178,000 acres of rubber from which returns were received.

Coconuts.—The percentage of estates submitting returns is so small that it would appear to be unwise to draw conclusions from them. Speaking generally, coconuts are planted on much flatter land than either tea or rubber and soil erosion is, in consequence, less rapid. Moreover, it is a common practice to allow or to encourage some sort of soil cover to grow under coconuts and this practice tends to minimise the danger of excessive soil erosion.

ACKNOWLEDGMENT

The writer wishes to acknowledge his appreciation of the assistance rendered by Mr. S. K. Thuraisingham, B.Sc., Technical Assistant, Department of Agriculture, in preparing the tables.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the thirty-second meeting of the Board of Management held in the Committee Room of the Ceylon Chamber of Commerce, Colombo, at 10 a.m. on Thursday, 21st May, 1936.

Present.—Mr. E. Rodrigo, C.C.S. (in the chair), Mr. C. H. Collins, C.C.S., Deputy Financial Secretary, Mr. L. B. de Mel, J.P., U.P.M., Mr. L. M. M. Dias, Col. T. G. Jayawardena, V.D., Mr. J. C. Kelly, Mr. F. A. Obeyesekere, Mr. C. A. Pereira, Mr. B. M. Selwyn, Mr. E. C. Villiers, M.S.C., Mr. E. W. Whitelaw and Col. T. Y. Wright.

Mr. R. K. S. Murray, Acting Director of Research, was also present by invitation.

Apology for absence was received from Mr. F. H. Griffith, M.S.C.

A vote of condolence on the death of Mr. C. E. A. Dias was recorded.

MINUTES

(*a*) Draft Minutes of the thirty-first meeting which had been circulated to members were confirmed and signed by the Chairman.

(*b*) *Matters arising from minutes*

1. *Technical Officers' Reports.*—It was decided to enquire whether the London Advisory Committee wished to have the reports of all the Technical Officers sent to them or only that of the Director of Research as the latter contained all the salient points mentioned in the others.

2. *Report of Small Holdings Committee.*—The recommendations of the Committee were adopted and it was decided that work should be started on the lines suggested, *i.e.*, with two Instructors in the Kalutara District. The Committee was re-appointed as a standing Sub-Committee.

2. BOARD

The following changes in the membership of the Board were reported :—

1. Resignation of Mr. J. L. Kotalawala consequent on his appointment as Minister of Communications and Works.
2. Nomination of Mr. J. L. D. Pieris to the seat rendered vacant by the death of Mr. C. E. A. Dias.
3. Nomination of Mr. L. M. M. Dias to the seat vacated by Mr. C. H. Z. Fernando.

Messrs Kotalawala and Fernando were thanked for their services and Messrs Dias and Pieris were welcomed to the Board.

3. DECISIONS BY CIRCULATION OF PAPERS

Application for grant from the Department of Industries

Reported that members had agreed that application should be made for Rs. 35,000 instead of Rs. 30,000 as decided at the last meeting.

4. PATENTS

(*a*) *Draft Amending Ordinance*

The draft Ordinance prepared by the Board's lawyers and revised by the Legal Draftsman was tabled. It was reported that this was gazetted on 3rd April and would be placed before the State Council in due course.

(*b*) *Examination of applications for Ceylon patents*

It was decided that the question of arranging with the Registrar-General for Examination of applications for patenting processes connected with rubber was not of sufficient benefit to be pursued.

5. VISIT OF AN OFFICER TO MALAYA

A letter from the Ceylon Estates' Proprietary Association, enquiring, at the request of the Ceylon Association in London, whether it would be possible to send an Officer of the Scheme to Malaya and the Dutch East Indies with a view to obtaining reliable information regarding the yields of budgrafted trees in commercial tapping in those countries, was considered. It was decided that Mr. Murray should undertake the visit on the return of Mr. O'Brien from leave in October next.

6. ACCOUNTS

(*a*) Statement of Receipts and Payments of the Board for the quarter ended 31st March, 1936, was approved subject to further information being given regarding (1) the amount shown as Cess Collections during the quarter, and (2) the disposal of the balance of the Government grant for the Sulphur Dusting Scheme.

(*b*) Dartonfield and Nivitigalakele Accounts for January and February, 1936 were tabled.

(*c*) Renewal of the following Fixed Deposits was reported :—

Rs. 10,000 at the Hong Kong & Shanghai Bank at 2 per cent. for one year from 19-3-36.

Rs. 10,000 at the Hong Kong & Shanghai Bank at 2 per cent. for one year from 20-3-36.

Rs. 60,000 at the Chartered Bank at 2 per cent. for one year from 20-3-36.

Rs. 10,000 at the Chartered Bank at 2 per cent for one year from 1-4-36.

7. STAFF

(*a*) Reported that Mr. T. E. H. O'Brien's new agreement was not yet ready for signature. A letter from Mr. O'Brien accepting the leave terms decided on at the last meeting was read.

(*b*) A letter from Mr. M. W. Philpott asking for his salary to be placed on an incremental scale was read and left over for consideration at the next meeting after circulation of all papers relative to his appointment.

(*c*) Changes in Junior Staff were reported.

8. EXPERIMENTAL COMMITTEE

(*a*) Mr. F. A. Obeyesekera and Mr. B. M. Selwyn were appointed to fill the vacancies caused by the resignation of Mr. J. L. Kotalawala and the death of Mr. C. E. A. Dias.

(*b*) Recommendations deferred at the Board Meeting of 19th March.

1. *Bungalow Lighting and Water Supply.*—The undermentioned rates of charges proposed by the Treasury representative for supply of electric current to staff bungalows were approved :—

Director's bungalow	Rs. 25 per month
Technical Officers' bungalows	Rs. 20 per month
Estate Superintendent's and Secretary's bungalows	Rs. 15 per month

2. *Manufactured goods.*—The recommendation that the sale of rubber tubing and other vulcanised articles made at Dartonfield should be encouraged with a view to demonstrating the possibilities of local manufacture was approved.

(*c*) *Recommendations made at meeting of 3rd April,* 1936.

The following recommendations were approved :—

1. Provision of a motor-shed for the Estate Superintendent's Bungalow.
2. Telephone extensions at Dartonfield.
3. Purchase of an Electric Blower.

9. VISITING AGENT'S REPORT

Left for consideration pending the submission of recommendations by the Experimental Committee.

10. PATENT FOR STEARATE CRUMB

Decided to authorise the Rubber Producers' Research Association to file an application for Letters Patent on behalf of an Officer of the Scheme for patenting the process for preparing a soft type of rubber from Stearate Crumb.

11. IRIYAGAMA DIVISION

Decided that Government be informed that the Board is willing to take over the Iriyagama Division provided that all excess of expenditure over revenue be met from the Rubber Restriction Fund up to the end of 1938.

TEA RESEARCH INSTITUTE OF CEYLON

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held in the Committee Room of the Ceylon Chamber of Commerce, Colombo, on Saturday, the 20th June, 1936, at 10 a.m.

Present.—Mr. James Forbes (Jnr.) (Chairman), The Hon'ble the Financial Secretary, The Acting Director of Agriculture, Col. T. G. Jayawardene, V.D., Major J. W. Oldfield, C.M.G., O.B.E., M.C., Messrs R. G. Coombe, I. L. Cameron, D. T. Richards, D. H. Kotalawala, M.S.C., R. P. Gaddum, E. L. Fraser, B. M. Selwyn, Dr. R. V. Norris (Director and Secretary), and by invitation, Mr. J. W. Ferguson (Visiting Agent).

Notice calling the meeting was read.

Minutes of the Meeting of the Board of the Tea Research Institute of Ceylon held on the 28th March, 1936 were confirmed.

MEMBERS OF THE BOARD

The Chairman reported that Major J. W. Oldfield had resumed his place on the Board, relieving Mr. J. C. Kelly. The Board recorded a hearty vote of thanks to Mr. Kelly for his valuable services.

SUB-COMMITTEES

Experimental and Estate Sub-Committees.—Read letter from Mr. I. L. Cameron, intimating that, owing to pressure of other business, he was reluctantly compelled to resign from the Experimental and Estate Sub-Committee.

The Chairman said Mr. Cameron's resignation would be received with much regret as he had taken the greatest interest in the work of the Committee. He asked the Board to record a cordial vote of thanks to Mr. Cameron for his services.

The Board unanimously decided to invite Mr. J. T. Young of Alupolla Group to join the Sub-Committee in place of Mr. Cameron.

FINANCE

(*a*) *Accounts.*—The Statement of Accounts as at 30th April, 1936, was approved without comment.

(*b*) *Government Loan.*—Read letter dated, 18th June, 1936, from the Hon'ble the Financial Secretary, intimating that, in response to the Board's application, the Board of Ministers had agreed to recommend to the State Council that the rate of interest on the Government Loan to the Tea Research Institute should be reduced from 6 per cent. to 5½ per cent. as from 1st October, 1935. A resolution to this effect would be moved in the Council on the 24th June.

EXPERIMENTAL AND ESTATE SUB-COMMITTEE

The following matters arising from the Minutes of Meetings of the Experimental and Estate Sub-Committee held on the 21st March and the 16th May, 1936, were considered :—

(*a*). *Pruning Cycle.*—Reported that the Committee had decided to extend the pruning cycle on St. Coombs to three years with the exception of No. 1 Field. Approved.

(*b*). *New Drier.*—The Committee recommended the acceptance of a tender by Messrs Davidson & Co., Colombo, for installation of a short 3-foot E.C.P. Drier in St. Coombs factory to replace the second Tilting Tray Machine.

The Chairman explained that this machine, which was to be specially designed for the Institute, would have a capacity of about 105 pounds per hour, and besides meeting the Institute's own requirements, would fill a very definite gap in the range of driers now available.

(*c*). Reported that arrangements had been made with the Department of Agriculture whereby the Institute would now take over work on Termites and Green and Brown Bug in so far as they concern tea estates.

(*d*). Reported that in view of somewhat extensive attacks of Helopeltis in the Deniyaya area, an experiment, designed to investigate the influence of manurial treatment on the incidence and severity of attack, had been arranged by the Institute on Enselwatte Estate.

(*e*). Reported that arrangements had been made for an experiment on St. Coombs Estate to investigate the effect of Selective Weeding.

Mr. Gaddum asked what were the views of the Institute concerning the recommendation of the Executive Committee of the Central Board of Agriculture in regard to legislation against the use of scrapers.

The Director said he had not received any further communication from the Board of Agriculture on the subject. The Acting Director of Agriculture promised that this would be rectified.

(*f*). Reported that, after studying the relevant yield records, the Committee had decided it would be inexpedient to replant No. 1 Field. It was, however, recommended provision should be made in the 1937 estimate for extensive re-supplying in other bad areas.

The recommendation was approved.

ST. COOMBS ESTATE

Visiting Agent's Report dated 29th May, 1936.

I. *Cultivation.*—Reported that in view of the alteration in the pruning cycle a revised cultivation programme had been drawn up by the Experimental and Estate Sub-Committee.

II. *Cart Road.*—Reported that the motor roller formerly hired for repair work was no longer available. The public Works Department had been asked to take on the work on contract but were unable to do so.

In these circumstances the Chairman considered it might be advisable to purchase a motor roller. There was a considerable programme of road work to be carried out and he thought an appreciable revenue could be earned by hiring out the roller to other estates when it was not in use in St. Coombs.

The Director stated he had made enquiries about cost. The most suitable type would be a Ruston-Hornsby Class C.O.R., Type E, Diesel Road Roller. The initial cost of such a roller would be about Rs. 7,000 and it was much more economical to operate than other types.

Mr. R. G. Coombe supported the Director's remarks in regard to the suitability of this make of roller.

Mr. Huxham enquired whether there would be any difficulty in carrying out repairs locally with a Diesel engine, Mr. Ferguson and Mr. Gaddum both considered that no trouble would arise on this account.

The Board approved the principle of the purchase of a roller and left the matter for decision by the Finance Sub-Committee after final figures of cost had been obtained by the Director.

III. Reported that Shot-hole borer had been found in a few bushes in No. 10 Field and necessary precautions had been taken against further spread.

IV. *Factory Inspection.*—Reported that the defects pointed out by the Inspector were all of a trivial nature relative to wiring and earthing of machinery. All defects had been made good by the Institute's Staff.

V. The Chairman reported that a sum of Rs. 231 had been provided in the estimate for repairs to the engine water tank. On stripping the inner surface, two walls were found in a dangerous condition necessitating immediate reconstruction. The bottom of the tank had also to be relaid. An additional sum of Rs. 340 was required for these repairs.

The Board sanctioned this expenditure.

VI. *Nurseries.*—The Chairman reported that the plants had not done well and it was estimated that 40,000 additional stumps would have to be purchased to meet the Institute's planting programme. The Visiting Agent had been asked to make necessary enquiries.

Arising from the Visiting Agent's report, Mr. Cameron enquired whether steps were being taken to increase the stand of Grevilleas. The Chairman replied in the affirmative and called attention to Mr. Ferguson's remarks on this point in his report.

In reply to Mr. Selwyn, the Chairman said the cost of firing on St. Coombs had been reduced by the use of firewood. The cost would also be permanently reduced by the installation of the new and more efficient driers.

Mr. Richards called attention to the leaks reported in the roof of the sifting room. The chairman said these had been due to the unexceptionally severe and windy weather in May. The matter would receive attention.

Rest House.—Mr. Coombs, with the permission of the Chairman, raised the question of providing a Rest House on St. Coombs. He thought the matter should be re-examined and, if approved, that provision should be made in the the 1937 estimates.

The Chairman pointed out that the Engledow report would probably raise questions of conferences and other meetings and proposed that the Rest House scheme should be considered when this report was examined.

Mr. Coombe accepted this suggestion.

SENIOR SCIENTIFIC STAFF

Leave Arrangements

I. Reported that Dr. Eden, Agricultural Chemist, had applied for home leave from the 23rd December, 1936 to the 7th October, 1937, in accordance with the terms of his agreement.

This was sanctioned, and it was decided that Dr. J. G. Shrikhande should act for Dr. Eden during his absence.

II. Reported that the Director was due for leave from the 21st February to the 18th September, 1937.

The leave was approved and it was decided that Dr. Gadd should act for the Director.

JUNIOR SCIENTIFIC STAFF

Research Assistant, Department of Biochemistry

The Board decided, Col. Jayawardene dissenting, to appoint Mr. H. B. Sreerangachar.

PASSARA SUB-STATION

(*a*). Reported that the Nayabedde Tea Co., Ltd., had agreed to let the Institute have the small area of land required for experimental purposes and had also accepted the Institute's proposals in regard to the upkeep of the road.

(*b*). Reported that the Passara buildings and equipment were now fully covered by insurance.

JUNIOR STAFF PROVIDENT FUND

The Board approved the recommendation of the Trustees of the Junior Staff Provident Fund that Mr. A. H. B. Dias, Accounts Clerk, be permitted to transfer the balance of his account in the Planters' Association Staff Provident Fund to the Institute's Fund.

PUBLICATIONS

Reported that copies of Mr. Carpenter's and Mr. Cooper's reports had been sent to Members of the Board. In view of the fact that these reports were issued on payment only, it would not be possible to reprint them in the Institute's publications.

TEA RESEARCH INSTITUTE CONFERENCE

In view of the prospective leave arrangements it was decided that the Institute's next Conference should be held at St. Coombs on Friday and Saturday, January 23rd and 24th, 1937.

The Chairman, the Director and the Chairman, Planters' Association of Ceylon were appointed as a Sub-Committee to consider necessary arrangements.

The Chairman referred to the suggestion made by the Director in the Annual Report for 1935 that separate conferences of a less formal nature should be arranged for Assistant Superintendents. It was decided this proposal should be considered later.

ANY OTHER BUSINESS

The Director referred to the report of the Engledow Commission of which extracts had appeared in the Ceylon Press, and stated that he had received a copy on the previous day. Additional copies had been ordered from Calcutta and these would be issued to the Members of the Board and of the Experimental and Estate Sub-Committee on receipt.

The Meeting terminated with votes of thanks to the Chair and to the Ceylon Chamber of Commerce for the use of the room.

ROLAND V. NORRIS
Secretary.

REVIEWS

Rubber Latex—By Henry P. Stevens and W. H. Stevens. *The Rubber Growers' Association Inc.* London, 1936, pp. 224.

HISTORICALLY, the use of latex as a raw material is not new in so far as it was employed at least 200 years ago by the inhabitants of the Amazon Valley in the production of rubber articles. In 1824 Hancock obtained patents for the preparation of fibrous rubber products and paints but his processes were never fully worked out because of the difficulty of transporting latex from the producing countries. The rapid development of recent years in the direct application of latex dates from the discovery of improved methods of preservation and shipment. To-day the applications of latex are so many and varied that the rubber producer cannot afford to be ignorant of the subject. In the last ten or twelve years the technical literature has grown to an alarming extent and in particular the patent literature is now so complicated that it is a matter of some difficulty to gauge from it the state of contemporary knowledge and industrial practice.

Many workers in this field have reason to be grateful to Messrs H. P. and W. H. Stevens and to the Rubber Growers' Association for a publication which summarises the position in its more important theoretical and practical aspects. This booklet is the fourth edition of one that first appeared in 1928. It is divided into two sections. The first half is devoted to the properties and behaviour of latex and to its production and industrial utilisation. Among the new subjects touched upon in the present edition are the measurement of stability, removal of water soluble constituents, the production of water paints, flooring and road surfacing materials. A paragraph is included on the botanical significance of latex and a brief description is given of some of the better known latices derived from laticiferous plants other than *Hevea*.

The second half contains a list of British Patents from 1920 onwards with application dates and short abstracts.

The booklet is intended mainly for the non-technical reader who wishes to learn something about the trend of developments in this comparatively new branch of the rubber industry. At the same time it is a book that provides rubber technologists with an excellent and much needed resumé of the existing state of our knowledge of latex.—M.W.P.

Humus. Origin, Chemical Composition, and Importance in Nature—By Selman A. Waksman. Ballière, Tindall & Cox, London, 1936, 30s. 6d.

Professor Waksman is well known to research workers in agricultural science as the author of an exhaustive treatise on soil microbiology entitled "The Principles of Soil Microbiology." During the past fifteen years he has, ably assisted by his students, carried out numerous researches on soil organic matter. His monograph on "Humus" now under review, is the natural outcome of these investigations and of his intimate acquaintance with the literature on the subject. On few matters of scientific interest is there so much diversity of opinion and confusion of ideas as on humus, but no one is better fitted to reconcile these conflicting views or to write with so much authority on the subject as the author. As to the result of his attempt, any impartial critic can return but one verdict—an unqualified success.

The book, in the author's words, "is an attempt to tell the story of humus, its origin from plant and animal residues, its chemical composition, its physical properties, its importance in nature, especially in soil processes and in plant growth, and finally its decomposition." Humus is defined by him as "a complex aggregate of brown to dark coloured amorphous substances, which have originated during the decomposition of plant and animal residues by micro-organisms, under aerobic and anaerobic conditions, usually in soils, composts, peat bogs and water basins." Emphasis is placed, and rightly, on the important fact that the chemical composition of humus is governed by the nature of the material from which it is derived, the conditions under which it was formed and the stage of decomposition. The writer therefore discusses in detail humus formation in composts, animal manures and green manures; in forest and heath soils; in field, grassland, garden and orchard soils; in peat and coal; and in water systems.

While the book is mainly devoted to the consideration of organic matter in relation to agriculture, it does not neglect the industrial aspect of the question. Comprehensiveness is one of its characteristics. It is divided into three parts. The first is an historical development of our knowledge of the chemical nature of humus, its formation and rôle in plant nutrition; the second deals with the origin and nature of humus; and the last with the decomposition of humus, its functions and applications. As would be expected, the work of the author and of his associates is incorporated in some detail. In the appendix the methods of analysis of humus and of its constituents are elaborated. A bibliography of no less than 1,311 references is included, as well as an author and a subject index.

The study of humus involves problems in various fields of science, and the botanist, physicist, chemist and microbiologist can all contribute towards their solution. Much ground has been covered, but much yet remains to be done. To all those who are in any way concerned with the conservation and utilisation of the natural resources of organic materials, the book should be of much value.—A.W.R.J.

(D.S. 207/2)

ANIMAL DISEASE RETURN FOR THE MONTH ENDED JULY, 1936.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1936	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	2515	900	2411	..	104	..
	Anthrax	..	..	..	..	..	..
	Rabies	16	..	..	..	..	16
Colombo Municipality	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1347	13	1324	15	8	..
	Anthrax	1	..	..	1	..	..
	Rabies	29	3	..	29	..	..
Cattle Quarantine Station	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	3	..	3	..	..	..
	Anthrax	24	3	..	24	..	..
Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1517	124	1490	8	19	..
	Anthrax	11	..	..	11	..	..
	Tuberculosis	2	1	..	2	..	..
	Rabies	7	..	..	7	..	..
Southern	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	11	11	5	..	6	..
	Anthrax	..	..	..	..	..	..
Northern	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	313	..	310	3	..	..
	Anthrax	..	..	..	..	..	..
Eastern	Rinderpest Foot-and-mouth disease Anthrax	FREE					
North-Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	2195	1090	1193	2	1000	..
	Anthrax	..	..	..	..	..	..
	Rabies	19	..	..	1	..	18
North-Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	683	22	677	..	6	..
	Anthrax	..	..	..	..	..	..
Uva	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	..	..	..	..	..	..
	Anthrax	..	..	..	..	..	..
	Rabies	2	..	..	1	..	1
Sabaragamuwa	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	2536	2195	662	31	1843	..
	Anthrax	..	..	..	..	..	..
	Haemorrhagic Septicaemia	3	..	..	3	..	..
	Rabies	3	1	..	..	..	3

Government Veterinary Department,
Peradeniya, 14th August, 1936.

M. CRAWFORD,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT—JULY, 1936

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Ins.		Ins.
Colombo ..	84·4	− 0·2	77·8	+0·8	76	82	8·0	1·88	12	− 4·08
Puttalam ..	85·9	+0·4	78·2	+0·1	72	86	5·4	0·02	1	− 1·34
Mannar ..	88·2	+0·2	79·6	+0·5	73	82	5·2	0·04	1	− 0·47
Jaffna ..	86·9	+1·0	79·6	+0·2	75	82	5·4	2·37	5	+ 1·81
Trincomalee ..	93·2	+1·4	77·9	+0·3	58	78	6·7	7·21	6	+ 5·34
Batticaloa ..	92·9	+0·4	77·3	+0·7	60	78	5·4	0·75	4	− 0·42
Hambantota ..	90·1	+2·3	76·5	+0·5	68	86	5·4	0·20	4	− 2·23
Galle ..	82·5	− 0·3	77·3	+0·5	80	84	5·6	5·22	19	− 1·48
Ratnapura ..	85·8	− 0·8	75·1	+0·7	76	91	7·0	11·86	22	− 1·48
Anuradhapura ..	91·0	+0·4	76·2	+0·4	62	88	6·5	1·97	5	+ 0·61
Kurunegala ..	85·8	− 0·6	75·9	+0·7	74	86	7·1	2·08	14	− 2·04
Kandy ..	82·0	− 0·4	71·6	+0·9	76	85	7·7	9·66	21	+ 2·04
Badulla ..	86·2	0	65·3	+1·7	62	92	5·7	1·00	8	− 1·39
Diyatalawa ..	77·6	− 0·7	62·6	+0·2	64	84	6·7	1·35	6	− 0·61
Hakgala ..	68·4	+0·1	57·0	−0·5	80	92	7·7	5·81	22	− 1·52
Nuwara Eliya ..	65·5	− 0·2	55·0	+0·4	88	94	8·8	11·25	26	− 0·58

The rainfall of July was generally above normal on the western and south-eastern slopes of the hills, in the extreme north, and in the north east of the Island. Elsewhere it was generally below normal, though an appreciable number of stations in these districts also showed excess. Excess was most marked in or near the Ginigathena Pass, where Kenilworth estate reported 13·42 inches above its average, and several other stations reported excesses of 5 to 10 inches. The greatest monthly total was 42·29 inches, at Kenilworth, while falls of between 30 and 40 inches were reported from other stations in or near the Ginigathena Pass. Deficits were greatest in the Western and Southern Provinces (except near Galle, where excess was reported) and in the districts between Matale and Maho, where rainfall stations were 2 to 5 inches below their average. Most stations in the districts near Puttalam reported no rain at all during the month.

16 falls of over 5 inches in a day were reported, chiefly on the 11th and 27th. The highest daily fall was 9·60 inches, at Halwatura, on the 27th, while Hiniduma, Kenilworth estate, and Kitulgala each reported two daily falls of over 5 inches.

As regards wind and barometric pressure, conditions continued consistently monsoonal during the month. There was fairly heavy rain in the south-west of Ceylon during the first four days of July. The rain then decreased, and very little was recorded till the 11th. On that day some heavy falls were recorded, chiefly in the south-west, while monsoon rains continued fairly heavy, with occasional local thunderstorms on the other side of Ceylon, till the 19th. From the 20th till the 25th rain was again light. On the 26th it increased in the south-west, while on the 27th and 28th it was fairly widespread over the Island, and on the 27th it was particularly heavy in the south-west of Ceylon. During the last few days of July there was very little rain.

Day temperatures were generally above normal in the north and east, and a little below normal elsewhere. Night temperatures were a little above normal. Humidity was above normal up-country, elsewhere generally below, while cloud was below normal in the north-west, elsewhere generally above, particularly up-country. Barometric pressure was above normal. Wind strength was below normal in the north-west, elsewhere above. Its direction was mainly south-westerly.

H. JAMESON,
Superintendent, Observatory.